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AN APPLICATION OF SOCIAL-PSYCHOLOGICAL THEORY
IN THE ANALYSIS OF THE CHOICE OF A SCIENTIFIC CAREER

by

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A THESIS

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled An Application of Social-Psychological Theory in the Analysis of the Choice of a Scientific Career, submitted by Victor Blake in partial fulfilment of the requirements for the degree of Doctor of Philosophy.

ABSTRACT

This dissertation reports an investigation of the interaction between selected personality and cultural variables motivating individuals to desire to follow careers in the physical sciences. Two groups of students desiring to become physical scientists were studied: (1) a group of students possessing the interests of physical scientists and (2) a group of students lacking the interests of physical scientists. In each case the Strong Vocational Interest Blank was used to measure the interests of physical scientists.

It was predicted that the group possessing the interests of physical scientists would have other characteristics that the literature has generally ascribed to physical scientists. These traits are emotional stability, introversion, poor social adjustment, poor family adjustment, the lack of the usual interest in economic rewards, less conformity, and the possession of a dominant interest in the discovery of truth and the systematization of knowledge. It was postulated that the group lacking the interests of scientists also lacked the other personality traits attributed to scientists and were therefore motivated to choose scientific careers by other factors. It was hypothesized that the group lacking the interests of scientists chose to follow scientific careers because they perceived science to have social desirability and they possessed the personality attribute of other-directedness, which made them susceptible to social influence.

It was found that the group possessing the interests of physical scientists scored significantly higher than the group lacking the interests

of physical scientists on the variables of Inner-Directedness, Systematization of Knowledge, Conformity, and Introversion; and scored significantly lower on Adequacy of Social Relationships. The group possessing the interests of scientists did not score significantly lower than the group lacking the interests of scientists on the variables of Neuroticism, Family Relationships, and Economic Concerns. Since the group lacking the interests of physical scientists scored significantly higher on the variable of Other-Directedness and perceived science and scientists to have social desirability, it was concluded that these were significant factors in motivating this group to desire to become physical scientists.

The squared multiple correlation showed that 47.2 per cent of the variance had been accounted for. The significant predictors in the presence of the other variables were the factors of Inner-Other Directedness and Systematization of Knowledge. Listed in descending order of the proportion that each factor contributed to the explained variance the variables are: Inner-Other Directedness, Systematization of Knowledge, Social Relationships, Conformity, Family Relationships, Neuroticism, Extraversion, and Economic Concerns.

There was a correlation of .409 between the variables of Sociable Extraversion and Other-Directedness. It was therefore concluded that the variable of Other-Directedness is not a pure measure, but has a factor in common with Sociable Extraversion.

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TABLE OF CONTENTS

CHAPTER	PAGE
I. INTRODUCTION	1
II. THE PROBLEM	8
Importance of Career Choice	8
The Specific Problem	16
III. REVIEW OF RELATED LITERATURE	19
Personality of Scientists and Science Students . . .	19
Relationships Between Interest Tests and Personality Tests	35
Attitudes Toward Science and Scientists	38
Summary	40
IV. THE THEORY	44
Review of Related Theories	44
Theoretical Approaches to the Study of Vocational Choice	44
Riesman's Theory of Social Character	46
Introduction to Riesman's Theory	46
Riesman's Typology of Character	47
The Change from Tradition-Direction to Inner- and Other-Direction	54
Tradition-Directed, Inner-Directed and Other- Directed Character Training	61

CHAPTER	PAGE
Contemporary Attitudes Toward Science	66
Theoretical Framework	67
Definitions	67
Theoretical Position	69
Hypotheses	71
V. EXPERIMENTAL DESIGN	75
The Sample	75
Description of the Tests	75
Strong Vocational Interest Blank	75
Maudsley Personality Inventory	76
Sociability-Impulsiveness Scale	77
Minnesota Counseling Inventory	78
Study of Values	81
Kassarjian's Test of Inner-Other Directedness	82
Determination of the Social Desirability That the Individual Perceives Science to Have	84
VI. RESULTS AND ANALYSIS OF THE DATA	86
Statistical Techniques Employed	86
Scores on the Psychological Tests	86
Ratings on the Paragraphs Describing the Social Desirability of Science and Scientists	89
Statistical Analysis of the Data	94
The t-Tests	97
The Pearson Product-Moment Coefficients of Correlation	99

CHAPTER	PAGE
The Multivariate Analyses	99
Comparison of the Findings with the Norms of the Psychological Tests	100
Summary of the Findings	110
VII. CONCLUSIONS, IMPLICATIONS FOR FURTHER RESEARCH,	
IMPLICATIONS FOR EDUCATIONAL PRACTICE	114
Characteristics Shared by the Groups Possessing and Lacking the Interests of Scientists	115
Variables Differentiating the Groups Possessing and Lacking the Interests of Scientists	117
The Relation of Other-Directedness to Extraversion	125
Limitations of the Study	126
Implications for Further Research	126
Implications for Educational Practice	128
BIBLIOGRAPHY	130
APPENDICES	
APPENDIX A. EXPERIMENTAL DATA	137
APPENDIX B. TESTS USED	144
APPENDIX C. CORRELATION MATRIX	146

LIST OF TABLES

TABLE	PAGE
I.. Socialization and Modes of Conformity	53
II.. Intercorrelations Among Selected Diagnostic Scales of the Minnesota Counseling Inventory for Grades Eleven and Twelve	80
III. Statistical Summary of The Scores Obtained on Kassarian's Inner-Other-Directed Scale by the Groups Scoring Low and High on the Strong Vocational Interest Blank	90
IV. Statistical Summary of the Scores Obtained on the Maudsley Personality Inventory by the Groups Scoring Low and High on the Strong Vocational Interest Blank	91
V. Statistical Summary of the Scores Obtained on the Minnesota Counseling Inventory by the Groups Scoring Low and High on the Strong Vocational Interest Blank	92
VI. Statistical Summary of the Scores Obtained on the Study of Values by the Groups Scoring Low and High on the Strong Vocational Interest Blank	93
VII. Correlation Matrix for Other-Directedness, Extraversion, Sociable-Extraversion, and Impulsive Extraversion	95
VIII. The Squared Multiple Correlation Coefficients Showing the Variance Contributed by Each Factor	96
IX. Comparison of Scores on the Variable of Neuroticism Obtained by the Groups Scoring Low and High on the Strong Vocational Interest Blank with the Norming Population of the Maudsley Personality Inventory	101
X. Comparison of Scores on the Variable of Economic Concerns Obtained by the Groups Scoring Low and High on the Strong Vocational Interest Blank with the Norming Population of the Study of Values	102

XI.	Comparison of Scores on the Variable of Family Relationships Obtained by the Groups Scoring Low and High on the Strong Vocational Interest Blank with the Norming Population of the Minnesota Counseling Inventory	103
XII.	Comparison of Scores on the Variable of Theoretical or Systematization of Knowledge Obtained by the Groups Scoring Low and High on the Strong Vocational Interest Blank With the Norming Population of the Study of Values	104
XIII.	Comparison of Scores on the Variable of Social Relationships Obtained by the Groups Scoring Low and High on the Strong Vocational Interest Blank with the Norming Population of the Minnesota Counseling Inventory	106
XIV.	Comparison of Scores on the Variable of Extraversion Obtained by the Groups Scoring Low and High on the Strong Vocational Interest Blank with the Norming Population of the Maudsley Personality Inventory	107
XV.	Comparison of Scores on the Variable of Conformity Obtained by the Groups Scoring Low and High on the Strong Vocational Interest Blank with the Norming Population of the Minnesota Counseling Inventory	108
XVI.	Comparison of Scores on the Variable of Inner-Other Directed- ness Obtained by the Groups Scoring Low and High on the Strong Vocational Interest Blank with the Norming Population of Kassarjian's Inner-Other-Directed Scale	109

CHAPTER I

INTRODUCTION

The answer to why individuals choose a particular career has been sought by many investigators. Psychological, sociological, and anthropological approaches have been used in attempting to answer the question.

Parsons in 1909 maintained that the choice of a vocation involved "three broad factors":

. . . (1) a clear understanding of yourself, your aptitudes, abilities, interests, ambitions, resources, limitations, and their causes; (2) a knowledge of the requirements and conditions of success, advantages and disadvantages, compensations, opportunities, and prospects in different lines of work; (3) true reasoning on the relations of these two groups of facts (Parsons, 1909, p. 5).

When Parsons formulated his theory, he had only a few psychological theories from which to draw. It is true that the writings of G. Stanley Hall and William James were available, but there is no evidence that Parsons had read the works of either man. There is no evidence that Parsons had read the early writings of Sigmund Freud and Freud did not lecture in America until after Parsons death.

Important anthropological and sociological investigations of social class, status, and structure appeared in the latter half of the 1920's. Such data combined with psychological contributions to stress the importance of motivations, class origins, culture, values, and the wholeness of the human personality.

The groundwork for the modern theories was explored in the 1930's in Austria and Germany by Buehler and Lazarsfeld. Paul Lazarsfeld, in

his Jugend und Beruf (1931), reviewed a large number of empirical studies undertaken by European investigators, and concluded that they all suffered from a major methodological error. Generally, the investigations had posed the question of why children want to enter certain occupations and professions and had assumed that a statistical tabulation of simple responses such as "I want to do what my father does," "I want to make a lot of money," would prove adequate for understanding the factors at work. This approach assumes that the motives which determine behavior can be studied directly and that the individual is able to select, out of all his experiences, the one or more factors that led him to adopt a particular line of behavior.

Karl Buehler's (1929) theory of motivation had demonstrated that the statistical analysis of stated reasons or motives for vocational preferences or choices would prove inadequate for studying the choice problem. He emphasized that every act or decision is always a combination of both internal and external factors. A mere tabulation of "reasons" for the choices of children therefore possesses, rather than eliminates, the arbitrary element in the selection of motives. Children cannot possibly evaluate the exceedingly complex matrix of experiences which must have entered into their decision-making, especially since they are not even conscious of some of the most important factors in their own background.

The late 1940's and early 1950's saw the publication of Robert Havighurst's (1948) speculations about developmental tasks and their elaboration in Fostering Mental Health in Our Schools (Association for Supervision and Curriculum Development, 1950). At this time developmental concepts began to be considered.

Two different theories of vocational life stages were put forth in 1951, one by a cross-disciplinary research team made up of Eli Ginzberg, Sol. W. Ginzburg, Sidney Axelrad, and John L. Herma; the other by two industrial sociologists, Delbert C. Miller and William H. Form.

Ginzberg and his associates (1951) interviewed selected groups of boys in New York City to see if any generalizations could be made about the types of occupational choices young people make before and during college. They concluded that there are three major periods through which most children pass: periods of fantasy, periods of tentative, and periods of realistic occupational choices. Their study also showed that there is a great variety and number of factors that influence the young person's job choices, that the choices shift, and that there are a number of factors influencing the job choices.

Miller and Form (1951) established a framework of life stages expressed in terms of work and called them Preparatory, Initial, Transition, Trial, Stable, and Retired.

Motivational theory, dealt with by Buehler in 1929, came into prominence in the late 1940's and is now under extensive investigation. Those concerned with motivational theory ask the intriguing question: Why do men work? The answer that one must work in order to eat does not completely answer the question. Most people who are financially independent engage in a wide variety of work.

Early investigators rarely asked this important question. It appears that they accepted a desire to work as a fact and proceeded from that premise. Sociologists raised questions about the meanings and

functions of work, and the rewards and status derived from work; psychologists posed theories of personality and began to investigate why people do what they do; anthropologists supplied information and theories about work and mores in various cultures. Vocational and educational experts then in increasing numbers turned to the questions: Why do men work? Why do men choose occupations that they do? What satisfactions do they gain from their occupations? What needs do their occupations satisfy? From the search for answers to these questions came many studies based upon motivational theories.

Various sociological studies produced evidence about points of view toward work. The impact of such studies seemed to be felt most directly after the publication of a study entitled Job Horizons (1949) by Lloyd G. Reynolds and Joseph Shister. They were testing the relationship between the heretofore nebulous concept, job satisfaction, and labor mobility.

Parsons (1949) listed four "generalized goals" which can be used to examine the problem of motivation generally as well as specific factors motivating people to work. The instrumental goal is that generalized goal that permits the individual to attain other ends. In occupational roles, the goal desired is often pecuniary. The income provided by the occupation enables the person to maintain a certain standard of living.

A second major generalized goal is the opportunity for recognition, that is, the feeling of being respected or valued by other significant people. There are few people who can develop a feeling of self-esteem

without reference to the opinions of others. The type of significant "other" varies widely from group to group. Many people are motivated by the fear of losing recognition. The desire for recognition may motivate the individual to attempt to acquire a position having more prestige, honor, or privilege.

Another generalized goal which individuals seek is security. Occupations may offer economic, social, or psychological security. For example, the position of a school teacher may offer economic security. The position of an army officer may offer economic and psychological security.

A fourth type of generalized goal is the opportunity of forming satisfying social relationships in which the individual feels reasonably certain of the continuing favorable responses of people important to him. Parsons labeled this goal response. The goal of response implies the need not only of receiving affection, but also of giving it. The goal of response may become very important in a social organization like that of a factory which is marked by anonymity, impersonality, and the absence of many close, well-knit groups.

Super (1957) synthesized lists of reasons for people working in The Psychology of Careers. He offered three major needs for which satisfaction is sought in work: (1) human relations, including recognition as a person (independence, fair treatment, and opportunity for self-expression) and status; (2) interesting work activity and satisfying work situation; and (3) livelihood incorporating current earnings and security. Super's list corresponds to that delineated by Reynolds and Shister (1949).

Roe (1956) in The Psychology of Occupations pointed out that any full-fledged theory of personality can be used to clarify work motivation, job satisfaction, and occupational choice. She chose Maslow's theory because it is "human-centered," deals with the individual as an "integrated, organized whole," and offers an "arrangement of basic needs in a hierarchy of prepotency." Roe stated that in explaining a person's behavior one must take into account biological, cultural, and situational factors.

Maslow's theory (1954), with which Roe worked, listed human needs in the hierarchy of (1) physiological and (2) safety followed by the needs for (3) belongingness and love; (4) importance, respect, self-esteem, independence; (5) information; (6) understanding; (7) beauty; and (8) self-actualization. Only when the lower needs in the hierarchy are satisfied can a man seek a higher need level.

Factors motivating individuals to choose scientific careers is the problem that receives attention in this investigation. The inquiry follows the strategies suggested by such investigators as Buehler (1929), Parsons (1949), and Roe (1956). Roe has stated that personality theory could be used to clarify work motivation. She has warned that in attempting to explain career choice cultural factors must be considered. Parsons (1949) has pointed out the generalized goal of wanting to be respected by other significant people. This investigation studies not only personality determinants of scientific career choice, but also the effect which cultural values have on certain personality types in the choosing of a scientific career.

It is speculated that today there are two distinct groups wishing to follow scientific careers. One group has the characteristics of those currently engaged in the physical sciences, that is, the inventoried interests and personality attributes of today's physical scientists. The other group, very likely, possess neither the inventoried interests nor the personality traits of today's physical scientists, but are motivated to choose a career in the physical sciences because they are other-directed and perceive a career in the physical sciences to have social desirability.

CHAPTER II

THE PROBLEM

A. IMPORTANCE OF CAREER CHOICE

In contemporary society every individual must choose a career. Since the beginning of modern capitalism one of the outstanding features of democracies is the right of the individual to choose his occupation. This is in contrast to totalitarian societies where the state dictates the occupation the individual must follow.

Present society has a high degree of specialization. The Dictionary of Occupational Titles (United States Employment Service, 1949) lists approximately six hundred major "job groupings" and a total of approximately forty thousand different jobs. From this large number of occupations the individual must choose one. The importance of the individual's choice can be considered from various points of view. First, there are those considerations pertaining to the welfare of the individual; second, there are those considerations pertaining to the welfare of society; and third, there are the problems faced by those who are directly concerned with aiding the individual make a wise career choice.

Thus occupational choice affects both the individual and society. Many people are directly concerned with career decisions. There is the young person who seeks to choose intelligently among various alternatives. There are the parents, who are uncertain whether they should offer their advice, and if so, in what manner. There are friends and advisors who

also influence the decision-making. There are teachers who may present materials and make judgments about various occupations and the way to prepare for them. Teachers together with psychologists and counselors may deal with the problem intermittently or constantly as an integral part of their daily work. Also concerned are those who construct curricula. They must ask themselves whether the material offered will assist the child to prepare for his adult role, including his role as a worker.

Making a wise occupational choice is important to the individual in two general ways. If the individual pursues a career in which he lacks interest, it is less likely that he will achieve his occupational goal than if his interests coincided with his chosen career. The second general way in which making a wise occupational choice concerns the individual pertains to his job satisfaction once he is working. By wisely choosing an occupation the person may find a large share of life's pleasure and satisfactions in his work.

Various studies have shown that there is greater likelihood that an individual will attain his occupational goal if he chooses a career in which he is interested than if he chooses a career in which he is not interested. Strong (1955) found that those who find a way to finance a higher education tend to complete training if their interests are appropriate to the career for which they are training. They tend to shift to occupations which are in line with their inventoried interests.

Strong (1955) showed that, on the average a man with an A rating on the Strong Vocational Interest Blank is 3.6 times more likely to enter

that occupation than any other occupation, including those occupations closely related to it. If the man has a C rating he is 0.2 times more likely to enter that occupation than any other. If this is expressed in expectancy ratios, there are 83 to 17 chances that a man with a C rating will not enter the occupation and 78 to 22 chances that a man with an A rating will enter the occupation.

Berdie (1955) also found that interests are indicative as to whether or not an individual will achieve his occupational goal in his chosen field. He reports the results from a comprehensive battery of aptitude, achievement, interest, and personality tests given to 1500 freshmen in 1939. The nine-year follow-up is based on 219 men and 262 women who obtained degrees at the University of Minnesota prior to 1949. Prediction of first-year grades is reported in terms of high school grades and test scores; prediction of vocational choice is reported in terms of course of study completed. Berdie concluded:

The results leave little question that vocational interest tests differentiate better among curricular groups than do other kinds of tests and that the prediction of which curriculum a student will graduate from can be better made with an interest test than with either aptitude tests or achievement tests.

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For those training programs which are at the college levels, differential aptitudes do not appear to be very important when compared to differential interests. . . . Differential education and vocational distribution at the college level, as shown by attainment of college degrees, is much more dependent upon motivations and interests than upon special abilities (Berdie, 1955, p. 114).

Sadler (1950) in comparing students who remain in the engineering curriculum with those transferring out, found statistically significant differences between the measured interests of the groups using the

Strong Vocational Interest Blank. The continuing engineer group had interests like those of successful engineers and chemists, whereas the transfers did not. The majority of the engineer group had interest patterns in the professional physical science group, whereas the transfer group did not.

Stuit (1941) reported that interests typical of successful engineers are an essential qualification for the field. Pierson (1947) also found that scores on the Strong Vocational Interest Blank were predictive of academic retention or persistence.

In the light of such research (Berdie, 1955; Pierson, 1947; Sadler, 1950; Strong, 1955) if the premise that attaining an occupational goal with minimal interruptions is accepted as desirable, the importance of the individual choosing an occupation which coincides with his interests becomes clear. If an individual's interests do not correspond to the interests of those engaged in the occupation, it is unlikely that he will complete his preparation for that occupation. Yet individuals spend time, and undertake considerable preparation for an occupation for which they do not complete their training. If the various reasons for individuals choosing such occupations for which they do not complete their training could be determined, then those concerned with helping individuals choose occupations, such as teachers and guidance personnel, would be in a better position to guide these students in the wise choice of a career.

Another general way in which making a wise occupational choice concerns the individual pertains to his job satisfaction once he is working. By the wise choice of an occupation a person may find a large

share of life's pleasures and satisfactions in his work. A job should furnish an outlet suitable to one's particular, personal emotional needs. According to Havighurst (1964, p. 226) certain jobs involve the greatest part of one's emotional life. Different professions and vocations offer quite different emotional outlets. A person may be adequately equipped intellectually, and have the special aptitudes for a certain vocation, but if that occupation does not offer the emotional outlet peculiar to one's needs, discontent and unhappiness may follow. Even though material and professional success may come, the person's occupation is likely to be an element of frustration throughout his life and make for unhappiness.

The experience of psychiatrists with this problem of choosing an occupation is reflected in Menninger's comment:

Perhaps three-fourths of the patients who come to psychiatrists are suffering from an incapacitating impairment of their satisfaction in work or their ability to work. In many it is their chief complaint.

.

Another index of our lack of scientific thinking in regard to the function of labor is our colossal ignorance and neglect of the problem of vocational choice. Here is one of the momentous decisions that cast the lives of human beings in fixed though diverse channels. Perhaps next to the choice of a marital partner, it is the most important and far-reaching decision made by the individual (Menninger, 1942, p. 170). . . .

Not only does the individual's job profoundly affect his life while he is at work, but it has a profound impact on all aspects of his life. The individual's work requires that he play a certain occupational role. Every member of society is expected to behave in a way which the society has defined as appropriate for his work role. In some cases if the role is sufficiently internalized it may affect the individual's entire personality structure (Rosenberg, 1957, p. 3).

Perhaps one of the most pervasive of the effects that an occupation has upon an individual is the people that his occupation causes him to associate with both on and off the job. Most people make more acquaintances on the job than they do in other ways; and in the usual lifetime situation, particularly in occupations like the professions or those in which the person is committed to long-term work, the individual largely meets others who are in his field (Roe, 1956, p. 297).

How leisure time is spent varies not only with income, but also in ways other than the demands made upon the individual as a direct consequence of his occupation. For example, there is some tendency for persons of the same general occupational status to live in the same neighborhoods. This affects available leisure time opportunities. There is a tendency for people having similar occupations to belong to the same clubs. In other words, an individual's occupation profoundly influences most aspects of his interrelations with other people (Roe, 1956, p. 299).

Also such matters as health and longevity have some association with the individual's occupation. There are some working conditions that are more likely to bring about both physical and mental hazards. Faris and Dunham (1939, pp. 20-84) and Hollingshead and Redlich (1953) report that mental illness is highest among people engaged in occupations having the lowest income and lowest prestige, and among those engaged in occupations having the highest income and highest prestige.

Investigation by Dubin (1956) did not find work to have such a pervasive influence on workers' lives as suggested by Havighurst (1964), Menninger (1942), and Roe (1956). Dubin studied in 1952-53 three

middle-western plants in the United States employing a total of approximately 1,200 workers. He found that three out of four of this group of industrial workers did not see their jobs and work places as central life interests for themselves. They found their preferred human associations and preferred areas of behavior outside of employment. Only 9 per cent of the industrial workers preferred the informal group life that was centered in the job. Nine out of ten of the workers studied indicated their preference for informal human associations and their contacts were found in the community among friends, and in the family. The workplace, then, according to Dubin, is not very congenial to the development of preferred informal human relationships. It is very likely that the emotional impact of work and the work environment, on the workers studied, was low in terms of general life experience.

On the other hand, Max Weber (1947) has pointed out that in formal organizations based upon rational authority with staff units organized in bureaucracies, the staff members are loyal to the legally established impersonal order of the organization. Extending this idea Dubin (1956) found that almost two out of every three of the workers studied identified their workplace as the locale of their preferred relationships with the purely technical aspects of their work; that is, the worker has a well-developed sense of attachment to his work and workplace without a total sense of commitment to it.

The occupational choice made by individuals has a profound significance for society in general. The young person who is choosing a career may not think about the impact of his choice upon human welfare.

But thousands of such choices will determine where serious shortages and surpluses of manpower will occur. Every society must somehow arrange to get people to do what has to get done in order to enable the society to survive and prosper. It must so distribute its human resources, both in quantity and quality, so that the needs of society will be satisfied.

Two sources of concern emphasize this point. The first is a report that the Soviet Union is producing a larger quantity of adequately trained engineers and scientists than America (Carnegie Corporation, 1955). The second is the existence of teacher shortages (Sheffield, 1958). Thus if a young person decides to become a salesman rather than an engineer, his decision has implications for his country. There is no assurance that the occupations young people will choose will meet the needs of the society of the future. Rosenberg (1957, p. 2) states that in many cases it is certain that the choices being made by young people will not meet the needs of society in the future; and society will then be faced, as it is now, with a maldistribution of its human resources.

It has been established that the choice of a career an individual makes is of profound importance both to the individual and to society. Certain individuals choose to prepare for occupations for which they lack interests, and as a result, many do not achieve their occupational goal. Those who do are likely to be unhappy. Society, on one hand, has people who cannot obtain employment; on the other hand, it has positions which cannot be filled because of a scarcity of trained personnel.

In summary, it is assumed that further information regarding

occupational choice may materially aid in: (1) enabling individuals to select occupations for which it is likely they will achieve their occupational goal with a minimal of interruptions; (2) helping individuals find those careers which will enable them to lead a rich, rewarding, and satisfying life; (3) aiding society in filling employment positions and providing individuals with employment opportunities; and (4) assisting those who are concerned with guiding individuals in the choice of a career.

B. THE SPECIFIC PROBLEM

In order to explain why individuals are choosing scientific careers today, this study will investigate the relationship between cultural factors and selected personality traits possessed by individuals who desire to follow a career in science. As used in this thesis "science" refers to the physical sciences and "scientists" to physical scientists. The method of investigation of career choice employed follows the theory of the cultural psychodynamic approach. It views the development of vocational choice as a result of subcultural factors interacting with personal psychodynamics.

Riesman (1961) has dealt with the extent to which an individual's actions are influenced by cultural factors. He has advanced the theory that "inner-directed" individuals have their own "psychological gyroscope" which keeps the inner-directed "on course." "Other-directed" individuals have their contemporaries as their source of direction. Such individuals would be influenced by cultural factors which today, especially as regards public attitudes towards science, are different than they were twenty, or even ten years ago. In the light of the foregoing and Riesman's theory

it is likely that some individuals are choosing scientific careers today who do not have the likes and dislikes or personality attributes of those presently engaged in science, and may therefore be expected to find a scientific career unsatisfactory. If the reasons which motivate individuals to choose scientific careers, especially those individuals who are unlikely to complete their training for a scientific career are understood, teachers, guidance personnel, and others will be in a better position to offer vocational guidance. They will have more adequate information to help individuals select an occupation for which it is likely they will achieve their occupational goal with a minimal of interruptions and which will enable the individual to lead a full and satisfying life.

There is general consensus, although it is not unanimous, as to the personality traits of those presently engaged in science. There is a certain amount of agreement as to the personality traits of students who have chosen scientific careers. This study is attempting to explain why individuals today are choosing careers in science; it also seeks to explain why investigators are in disagreement as to the attributes possessed by students selecting and preparing for scientific careers. It is postulated in this investigation that there are actually two distinct groups choosing scientific careers today. When these two groups are dealt with as one group contradictory results are obtained. If the two groups were dealt with separately, it is hypothesized, consensus as to the personality traits of those choosing scientific careers would be found.

It is postulated that one group of students who desire a scientific

career have the likes and dislikes of those engaged in science as measured by the Strong Vocational Interest Blank. The other group of students who expressed a desire for a career in science, it is hypothesized, do not have the likes and dislikes of those presently engaged in science. It is postulated that the group having the likes and dislikes of those presently engaged in science, as measured by the Strong Vocational Interest Blank, will have personality attributes more like those generally ascribed to scientists than the group whose likes and dislikes are unlike those presently engaged in science. It is hypothesized that the latter group have the personality characteristics of other-directedness which makes them susceptible to the influence of social considerations and they regard the choosing of a scientific career as being socially desirable.

High school males in the twelfth grade who express a choice for a scientific career were examined to determine those psychological and sociological characteristics which would appear to follow from the preceding theorizing.

CHAPTER III

REVIEW OF RELATED LITERATURE

This investigation examines the interaction between personal and cultural variables that may help to explain individuals' choice of a scientific career. The study examines personality traits, vocational interests, and individuals' perceptions of the social desirability that science and scientists enjoy in our society. The major emphasis is on the interaction between personality attributes and the social desirability the individual perceives science and scientists to have. Various other studies have dealt with dimensions that this study examines. The literature in three areas that is related to the present investigation is reviewed: (a) personality traits of scientists and science students, (b) the relationships between high scores in science areas on interest tests and personality tests, and (c) individuals' attitudes toward science and scientists

A. PERSONALITY OF SCIENTISTS AND SCIENCE STUDENTS

Various studies have been done that provide information as to the personality factors that may cause people to enter scientific fields. Shannon (1947) sought the traits of 250 world-renowned research workers by examination of their biographies. He found that those in the physical sciences compared to those in the social sciences rated higher on the following traits: anti-sociability, nonsociability, independence, dissatisfaction, and skepticism.

Roe (1951, 1952, 1953a, 1953b) has done intensive studies of researchers in the biological, physical, and social fields. She examined twenty eminent biological scientists, twenty-two eminent psychologists and anthropologists, and twenty-two eminent physicists. Roe's methods included a detailed life history of each subject, the performance of her subjects on the Rorschach and Thematic Apperception Test, and a careful evaluation of their work.

Roe found, generally, that the psychosocial development of most biologists and physicists was slow. It was rare for them to engage in extensive dating in high school or early college years. They speak of having been very shy and ill at ease with members of the opposite sex. Half of the social scientists Roe studied began dating in high school and dated extensively from then on. Only four of them did very little or no dating until they were through college. For the social scientists shyness was rarely the serious problem that it was for many of the biologists and physicists.

Early in life the biologists and physicists adapted ways of life which involved very much less personal interaction than found in the lives of the social scientists. Many of them still show very little interest in other persons and are much less interested in interpersonal relations than are the social scientists. They showed considerable lack of need for interpersonal relations, and somewhat more facility in avoiding them. The physicists were remarkably free from guilt that could accompany indifference to close personal relations. Most of the physical scientists did not particularly like to be with

people socially outside of the family.

Most of the physical scientists as boys were rather independent. They played with one or a few close friends, instead of with a gang. They followed their own particular interests with somewhat more than the usual intensity. Such interests were more often intellectual than not.

Both biologists and physicists showed considerable independence of parental relations without guilt feelings. This was particularly the case with physicists. The social scientists showed many dependent attitudes and much rebelliousness towards their parents, often accompanied by guilt feelings.

Most of the physical and biological scientists were happiest when they were working--some only when they were working. In these individuals extrinsic motivating factors, such as economic return, and social and professional status, were of secondary importance to their work itself.

Curiosity played a major role in the motivation of the physical scientists. It was crucially important to these individuals that they set their own problems and investigated what interested them. They disliked being told what, when, or how to think.

Drevdahl (1954) examined sixty-four students who volunteered to be studied. They were drawn from advanced undergraduate and graduate students in the various arts and science departments of the University of Nebraska. The students were rated by members of the faculty of the University of Nebraska who were well-acquainted with

the students and familiar with evaluative techniques. Using Cattell's Sixteen Personality Factor Questionnaire it was found that the arts group was significantly less stable and controlled, more sensitive emotionally, and more insecure and tense than the science groups.

Bello (1954) studied ten scientists from universities and ten scientists from industry. He found that with very few exceptions they were not very gregarious and not particularly interested in sports. On the other hand, they read extensively at home or in public libraries.

Teevan (1954) examined eighty-five male students from Wesleyan University to determine whether or not the personality of an individual was correlated with his choice of a major field in college. He examined the students, ranging in ages from seventeen to twenty-five years, with the Blacky Pictures. This is a modified projective technique measuring psychosexual development. He examined students in the following areas: (a) music, arts, German, French, and English (N=29); (b) government, economics, and history (N=28); and (c) geology, astronomy, biology, physics, and chemistry (N=28). Only those students who had a B- or higher standing were used in the investigation. Teevan found that the social science division had significantly higher disturbance scores on oedipal intensity and guilt feelings. The science division had the lowest disturbance scores.

Terman (1954, 1955) sought differentiating factors between scientists and nonscientists by studying 800 men of his original gifted group which was selected in 1921-22. A biographical data

blank completed by the subjects in 1951 showed various differences between scientists and nonscientists. The blank rated the subjects on matters pertaining to social adjustment including ratings on the following areas: interest in social success at ages twelve to twenty, interest in outdoor sports at ages twelve to twenty, social adjustment in childhood and youth, extent to which the individual did not feel "different" from other children, admiration for mother in childhood and youth, extent of affection and understanding between the son and his father, extent to which the individual was free from inferiority feelings, and the degree to which the individual had tended to conform to authority or convention (as contrasted with tendency to rebel). The science groups (physical scientists including engineers, and medical-biological scientists) rated much lower than the nonscience groups (social scientists, lawyers and those in the humanities). The only high rank of a science group on any of the variables was that of the engineers who scored second of all the groups on freedom from inferiority feelings. Thus, Terman found that the scientists as a group have poorer social adjustment than the nonscience groups and the science groups scored lower than the nonscientists on social relations, with traits of loneliness, shyness, and slowness in social development.

Cattell and Drevdahl (1955) studied the personality profiles of ninety-six biologists, ninety-one physicists and one hundred and seven psychologists using their Sixteen Personality Factor Questionnaire. Committees chose from their professional societies between 200 and 250 scientists from the areas of teaching, administration, and

research. The committees were instructed to choose about twice as many researchers as teachers and administrators. The sample was restricted to American scientists. It was found that this group of scientists differed markedly in their personality characteristics from those of the general population. In comparison to the general population it was found that the scientists were more adventurous, more sensitive, freer from paranoid trends, of greater ego-strength and dominance, had less free-floating anxiety, and were slightly more radical and self-sufficient. The scientists were lower in their emotional adoption of standard moral goals. They were decidedly higher on strict, internalized and intellectualized standards, and higher on exacting demands on the self.

Brandwein (1955) studied sixty-two students of Forest Hills High School, New York City, who were enrolled in three years of enriched science and in three years of mathematics. The group consisted of both students who wished to make science a career and those who had not expressed such a desire. The sixty-two students were selected between the years 1945 and 1951 from those enrolled in the enriched science course on the basis of factors which were judged to predispose an individual toward science.

All except six students in the experimental group, that is, those enrolled in the enriched science program, had become chairman of a subject class. Rarely did they seek to serve in student government offices. They sought positions which involved intellectual pursuits primarily. The sixty-two students in the control group had a total of thirty-seven posts of a political nature, such as president

of the student government and manager of the school newspaper.

The students in the experimental group compared to their age-mates without science vocational interests tended to be more interested in intellectual pursuits, such as reading Harper's and the Scientific American, listening to classical music, attending the theater, and playing musical instruments. The science group had a stronger tendency to do social work. They tended to be more conservative in their clothing. Almost never did they smoke until their senior year. Many did not smoke at all. The control group tended to smoke early.

In general, the science-oriented students were more quiet, more reflective, more inward looking. They usually exhibited a tendency toward introversion as compared to the other students.

MacCurdy (1956) studied students who in 1952 or 1953 were winners or honorable-mention winners in Science Talent Search. The respondents were enrolled as undergraduates in American colleges. Questionnaires were mailed to three hundred students who graduated from American high schools in the class of 1952 and were, for the most part, college sophomores; and to three hundred who graduated from American high schools in the class of 1953 and were, for the most part, college freshmen. Approximately 88 per cent of these students indicated professional choices in scientific or engineering fields, or in teaching presumably in these fields.

A comparison group consisted of forty freshmen and thirty-eight sophomores from the College of General Education, Boston University. Each student of this group had an intelligence Quotient of 120 or better

and in age, sex, and educational level was very similar to the group of science students.

MacCurdy developed an instrument consisting of 300 items which related to such categories as personality, attitudes, opinions, activities, and interests. Using his instrument he found that the science students were significantly different at the .01 level from their contemporaries in general education in several characteristics. The science students showed a strong sense of control and self-discipline. They controlled their own tempers and persisted on a job to its completion. They respected suspended judgment and sought truth from empirical evidence. Almost all of them consciously tried to separate their judgment from their likes and would quickly change their opinion if proved wrong. These students recognized the interdependence of science and society and questioned the misuse of science. Many appreciated the values of such complex things as symbolic art and classical music.

MacCurdy found that the science students were social-minded and recognized the importance of other people. They obtained scientific knowledge and help from others and felt a responsibility to others. The science students had a desire and often the opportunity to be leaders, for they were elected officers in student government and they enjoyed being group leaders in science.

On the other hand, MacCurdy states that the science students were somewhat antisocial for they usually preferred to work and study alone, and preferred not to share their play and their pleasures with other people. They did not enjoy parties. They did not date the opposite sex

as often as twice a week. Their interests were of a solitary, scholarly nature. The science students lacked athletic interests, but had hobbies of reading and studying.

Stone (1957) employed a study population of fifty male college students who had successfully completed a physical science and mathematics curriculum. The study population's mean scores differed significantly from those of the normative populations published by the authors of the Thurstone Temperament Schedule on six of the seven scales. At the .05 level of significance the study populations scored lower on the following: active, works and moves rapidly; dominant, thinks of himself as a leader, capable of taking initiative and responsibility. At the .01 level of significance the study population scored lower on the following: vigorous, uses large muscle groups and great expenditures of energy impulsive, makes quick decisions and enjoys competition; sociable, enjoys the company of others and makes friends easily. The study population was higher at the .01 level of significance on the reflective scale, likes meditative and reflective thinking. The two groups did not differ significantly on the stable scale.

The study population's mean scores were also significantly below those of the normative population on four of the five variables of the Minnesota Personality Scale. At the .01 level of significance the study population scored lower on the following: family relations, high scores usually signify friendly and healthy parent-child relations, whereas low scores suggest conflicts or maladjustments in parent-child relations; economic conservatism, high scores indicate conservative economic

attitudes, whereas low scores reveal a tendency toward liberal or radical points of view. At the .05 level of significance the study population scored lower on the following: social adjustment, high scores tend to be characteristic of the gregarious and socially mature individual in relations with other people, whereas low scores are characteristic of the socially inept or undersocialized individual; morale, high scores are indicative of belief in society's institutions and future possibilities, whereas low scores usually indicate cynicism or lack of hope in the future.

Strauss (1957) studied the lives of eighty-nine men who earned the Ph.D. degree in physics, chemistry, and engineering at the Ohio State University, the University of California at Berkeley, and Cornell University. Teachers who remembered the men when they were in high school were interviewed. Strauss found that the scientists studied did not show any discernible and characteristic peculiarities. They engaged to a considerable degree in high school and collegiate extracurricular activities. They were greatly influenced by other people, and they came from families at all social and economic levels. As adults they enjoyed social contacts, engaged in many and varied forms of recreation, and frequently took part in community and church activities. Strauss concluded that the scientists, and the scientists when they were students seemed to be what may be regarded as normal persons.

After arriving at this conclusion, however, Strauss (1957) stated that he did find a dominant force shaping their lives. This force was drive, that is, an urge that made them work hard for many years often

under the most difficult conditions, and persevere in spite of many hurdles and obstacles in their path. In a surprisingly large number of cases the drive seemed to have been due to frustrations that generally occurred early in their lives, such as the failure to be accepted as an equal by the peer group, or by family pressures and tension, or by minority status; or by some combination of these three and other minor factors.

Strauss found the presence of a degree of nonconformity among scientists. The nonconforming behavior showed up early in life and was frequently reported by the high school teachers visited during the investigation. Although the boys did not always do what was expected of them, they were seldom anti-social.

Vineyard (1959) studied the entire freshman and sophomore class of regularly enrolled students during the 1957-58 school year at Panhandle A. and M. College. The students numbered 251 of whom 56 were science majors and 195 majors in other fields. Those who indicated on their forms majors in chemistry, physics, mathematics, engineering, general science, geology, biological science, pre-medical, pre-dental, pre-nursing were considered to be science majors. All other fields were classified as nonscience.

Vineyard found that freshmen and sophomore students who chose science as a major field did not differ from students who majored in other fields in the following traits as measured by the Guilford-Zimmerman Temperament Survey: inactive vs. energetic, shyness, vs. sociability, emotional instability vs. stability, hypersensitiveness vs. objectivity, hostility vs. friendliness, unreflectiveness (extra-

version) vs. thoughtfulness and reflectiveness (introversion), and criticalness vs. cooperativeness. Science and nonscience majors differed in two other personality traits with science majors tending to be either definitely impulsive or to be moderately serious and restrained and tending to be more dominant than submissive as a group than nonscience majors.

Eiduson (1962) studied forty research scientists selected solely on the criterion of choice of their profession and its pursuit in an academic and research-oriented atmosphere. The scientists ranged in age from 28 to 65 with a mean of 41.7 years. Some were engaged in teaching, and most engaged in some administrative duties, but they all considered themselves primarily research scientists. Six of the scientists worked in physics, six in earth and soil sciences, twelve in chemistry, and sixteen in the biological and zoological sciences. They had all been in science for an average of fifteen years beyond the Ph.D. degree. The most prolific of the researchers had produced over two hundred scientific books and articles; the least, three. Eiduson subjected the scientists to projective tests and intensive clinical interviews about themselves, their early development, and their personal history. The test data was then turned over to judges who knew nothing about the nature of the study. They were asked to rate the subjects on a rating scale which was based on the hypotheses that repeatedly described the creative person in various publications.

Eiduson found that the scientists had certain characteristics as children and adolescents. Their family relationships were atypical. There was little intimacy between the scientists and their families.

Those positive ties that did exist were related to achievement. The cold emotional climate in which the men grew up had little of the intimacy, warmth, or close family relationships that is often thought so important for children. In almost half the cases the father was absent or at home so little that the child scarcely knew him. Their fathers were not liked very much either by the scientists who knew them well, or by those scientists who scarcely knew them. Generally, the fathers were described as rigid, stern, aloof, and emotionally reserved. The hard disciplinarians were described as embittered men who were reacting to personal defeats.

Only a handful of the American-bred scientists seemed to have made psychological peace with their mothers. A few expressed sympathy with the fearfulness, the limitations, and the language handicaps they saw in their mothers. More often, however, the scientists saw their mothers as being overprotective and possessive, immature, anxious and fearful, hysterical, neurotic, and filled with psychosomatic complaints; or as being too aggressive, too driving, too uninvolved in their children, and too undemonstrative. The search for second or substitute mothers was repeated in a number of histories. But many others, with difficult mothers, had disordered and unhappy childhoods.

As children and adolescents, the scientists' social relations were meager. They did not exhibit the same degree of interest in children's games and activities as other children. Seldom did they engage in organized play. Only a few of the scientists were members of Boy Scouts or community clubs. As adolescents they had few contacts with girls. They were generally shy, bashful, and inhibited in their

relationships.

One feature in the young lives of the scientists was consistently mentioned throughout the interviews. As children the scientists had periods of isolation from the customary groups with which a child might be expected to identify. The isolation sometimes lasted for years at a time. Occasionally such withdrawal resulted from physical illness, but more often these were periods which the individual felt emotionally distant from friends of his age.

As adults Eiduson found the scientists to have characteristics that did not differ greatly from those they possessed as children and adolescents. As a group, the scientists, were found to lack free-floating anxieties and fears. They would be classified as character types rather than as neurotics because they showed so few symptoms of anxiety and tension. The scientists made relatively constant, habitual adjustments in the face of problems or conflict situations. Scientists were challenged by anxiety-producing situations rather than being overcome by them. They were not given particularly to changes of mood; they were not particularly passive, submissive, or dependent; they were not ridden by ambivalent conflicts or conflicts over sexuality, authority or performance. They did not shy away from strong interpersonal relationships and were sensitive to the moods and feelings of others.

Their work was found to be central to their lives. They felt that most of their individuality and personality came out in their work, and what they as individuals could contribute uniquely was drawn out in studies and in the laboratory. Curiosity was found to be a major deter-

minant in their work. They had strong emotional leanings to intellectual activity, and strong ego involvement in their work. Material gain was not an important factor in motivating the scientists in their work. So far as money was concerned, the scientists attitudes seemed notoriously unconventional and strange.

The scientists relations with their families were not typical. The interviews revealed that the scientists were not able to give the most significant parts of themselves to home and family. Even very severe family problems aroused relatively little conflict in the scientists. Scarcely any aspect of life could compete with their work for the emotional involvement of these men.

Cattell (1963) concluded after studying the biographical data of scientists that they had certain traits. He found that scientific researchers, and particularly physical scientists, were withdrawn, skeptical, internally preoccupied, precise, and critical men. He found that the emotional stability of effective scientific researchers was distinctly higher than that of literary geniuses and the general public. Cattell found natural scientists to be more introspective, restrained, solemn, emotionally sensitive, and radical than nonscientists. The scientific researcher was more paranoid, anxious, and introverted than the general college population from which they came.

After examining the biographies of the more original scientific researchers Cattell found certain characteristics not generally esteemed. The highly creative scientists showed a decided lack of humility together with high dominance and a lack of forbearance.

Cooley (1963) followed in five years the career choices and educational development of some seven hundred boys between the fifth grade and the end of graduate school. Among these students he found two groups: (1) the potential scientist pool, that is, those boys who attended a four year college and majored in one of the natural sciences or engineering with plans to pursue a career in science, applied science or engineering; (2) the college-nonscience group, that is, those who attended a four year college, who majored in something other than science or engineering, with no plans to pursue a career in a scientific field. He found that on the Guilford-Zimmerman Temperament Survey the potential scientist pool, compared to the college-nonscience group, scored significantly higher at the .01 level on Restraint, Serious, Thoughtful, and Reflective. On the Work-Values Questionnaire the potential scientist pool scored higher than the college-nonscience group on the invent, theorize, and well-known scales. Cooley concluded that the potential scientist pool placed a higher value on ideas and recognition than on variety and power.

Knapp (1963) studied seniors at Wesleyan University who were science and nonscience majors. All the students examined had an academic average of B or better in their major field. Knapp employed three projective tests in the examination of the students: a group Rorschach, the Blackie Test as devised in Gerald Blum, and a group Thematic Apperception Test as devised by David C. McClelland.

The Rorschach contributed little to differentiating the science and the nonscience majors.

Using the Group Thematic Apperception Test the science majors were found to be conspicuously and significantly lower on the dramatic saliency variable. Since the dramatic saliency variable can be regarded as a measure of creativity, it must be concluded that the science students were quite uncreative in imagining and contriving structured human relations. Using the Group Thematic Apperception Test it was demonstrated that the science students were lowest in expressions of hostility to the father or father surrogate. A very high incidence of hostile father figures was a marked characteristic of students in the humanities. With reference to the mother figure or surrogates thereof, no significant differences among the groups of students were observed. The purpose of the Blackie Test is to identify fixation at different Freudian psychosexual levels, or sensitivity to typical traumatic experiences of childhood. The results showed marked oral fixation among students of humanities, and also patterns of fixation among those in social studies. The students of science were the least disturbed on all the variables.

Knapp concluded that scientists did not deeply involve themselves emotionally in dealing with and considering human relations. Moreover, they were disposed to employ repression and isolation in coping with feelings arising from interaction with people.

B. RELATIONSHIPS BETWEEN INTEREST TESTS AND PERSONALITY TESTS

There is inconclusive evidence as to the relationship that exists between high scores in various areas on interest tests and scores attained on personality tests. Darley (1938) studied students registered in the

General College of the University of Minnesota who had largely A and B+ scores on the Strong Vocational Interest Blank in the technical fields of chemist, engineer, scientific farmer, mathematician, physicist, psychologist, and artist. Using the Minnesota Scale for the Survey of Opinions he found that the students he studied had greater feelings of inferiority than men with interests in business contact or social contact jobs. Using the Adjustment Inventory he found that those scoring high on the Strong Vocational Interest Blank in the technical areas had markedly poorer social adjustments, had fewer social preferences, and had more limited social skills than men in nearly all other interest groupings. They showed, nevertheless, a tendency for consistently better home, health, and emotional adjustments than the other interest groups. They also showed less conservatism with regard to legal, economic, and educational questions that did the men in the other groups.

Sarbin and Berdie (1940) analyzed the scores made on the six Allport-Vernon scales by students with various interests on the Strong Vocational Interest Blank. Fifty-two students were studied. Students with interests predominantly in the physical science areas scored higher on the theoretical value scales than students whose interests were in other fields.

Berdie (1943) studied 136 men who came to the Testing Bureau of the University of Minnesota as pre-college cases in the spring and summer of 1940. He found that students with measured vocational interests on the Strong similar to those of engineers showed themselves

to be lacking in social interests or skills with fewer of their values centering about people than students in other areas. They participated in few cultural and religious activities and few extracurricular activities in high school.

Tyler (1945) tested a group of college sophomores who consisted of 55 men and 122 women who were registered at the University of Oregon during the fall term of 1941-42. The tests used included the Strong Vocational Interest Blank and the Minnesota Personality Scale. He found that there was a general lack of relationship between interest scores and what is loosely termed "neurotic tendency." He found no correlations between interests and family adjustments and only one low significant correlation between interests and emotional adjustment. None of the items on the social scale referring to relatively serious maladjustments or neurotic symptoms differentiated any of the interest groups.

Cottle (1949) examined a population of 400 adult male veterans expressing an interest in training or placement in professional level occupations in order to ascertain whether relationships existed among the thirty-four scales comprising the Minnesota Multiphasic Personality Inventory, the Strong Vocational Interest Blank for men, the Kuder Preference Record, and the Bell Adjustment Inventory student form. He did not find much relationship between the personality and interest inventories, although the personality inventories appeared related and the interest inventories appeared related.

Feather (1950) studied 503 students attending the University of Michigan. Three-fourths of the students were veterans and about one-

fourth nonveterans. The group used was arbitrarily divided into "normal" and "maladjusted" by the use of standards established for the Minnesota Multiphasic Personality Inventory, that is, those with T-scores of seventy or less were classified as "normal" and those with T-scores of seventy or above were classified as "maladjusted." Over 80 per cent of the cases were men, of whom a similar proportion were in the maladjusted group. The normal group had significantly more individuals with high scores on the Mechanical and Scientific scales of the Kuder and fewer with high scores on the Musical, Literary, and Artistic scales.

C. ATTITUDES TOWARD SCIENCE AND SCIENTISTS

Investigators have found conflicting evidence as to the esteem that science and scientists possess in North American Society. In 1956 the Purdue Opinion Panel (Remmers and Radler, 1957) polled in the United States a nationwide sample of high school students on their attitudes towards science and scientists. It was found that about 30 per cent of the sample thought scientists were odd and had an unhappy life. Fourteen per cent thought that there was something evil about scientists and 25 per cent thought that scientists as a group were "more than a little bit odd." Thirty per cent declared that it is impossible to raise a normal family and become a scientist.

Mead and Metraux (1957) analyzed over forty-eight thousand essays written by students across the United States. In essence it was found that only a minority of students had a favorable image of the scientist, while a majority reported distinctly negative reactions.

Beardslee and O'Dowd (1962) examined in 1958 and 1959 twelve hundred undergraduate men and women in four colleges in the northwestern United States. They found that students saw scientists as highly intelligent with a strong tendency to be both individualistic and radical in personal and social outlook. At the same time, the students saw scientists as socially withdrawn, indifferent toward people, retiring, and somewhat depressed. They rated the scientists low in social popularity. The scientists were believed to have a relatively unhappy life.

The National Association of Science Writers (1958) studied the image high school seniors in the United States had of scientists. It was found that most of the students held a favorable image of scientists. The negative picture of the scientist included such traits as socially inept, neurotic, queer, overly dedicated to science, ideologically deviant, and hard to know. The positive picture of the scientist included such characteristics as intelligent, studious, normal, well balanced, humanitarian with a strong sense of social duty, and creative and imaginative. When the respondents were asked to guess what sort of a person a scientist might be, 62 per cent included only positive traits and only 7 per cent mentioned exclusively negative traits.

Allen (1959) studied during the 1956-57 school year a sample of New Jersey high school students in their senior year. Approximately three thousand students were included in the study. He found that the students, taken as a group, possessed attitudes favorable to science. Generally, the New Jersey students rejected characterizations of scientists as "longhairs," and "odd lot," "communists," and against formal

religion. They felt that science and technology have not only enriched society but are essential to its full development. Although the image of the scientists which characterized the group as a whole seemed favorable, about 25 per cent thought that scientists were too narrow in their views, too emotional, and willing to sacrifice the welfare of others to further their own interests.

D. SUMMARY

With regard to the social relations that scientists and science students enjoyed two pictures emerge: one, that of little social interaction with others and introversion; and the other, that of leading a normal social life, and extroversion. Several studies (Eiduson, 1962; Roe, 1952; Shannon, 1947; Stone, 1957; Terman, 1954) have shown that scientists and science students were slow in psychosocial development, showing less interest in interpersonal relations than individuals in other occupations. The natural scientists were found to have poor social adjustment, to have limited acquaintances, to exhibit shyness, and to follow their own interests with more than the usual devotion.

Some investigators (Brandwein, 1955; MacCurdy, 1956; Strauss, 1957) found that science students showed normal interpersonal relations. Such studies showed science students and scientists were social-minded, enjoyed social contacts, recognized the importance of other people, were greatly influenced by other people, were sensitive to the moods and feelings of others, and did not shy away from strong interpersonal relationships. They had become leaders in organizations that consisted of their peers

and they enjoyed being leaders. They engaged to a considerable degree in high school and collegiate extracurricular activities.

The family relationships that existed between the science students and their families were atypical (Eiduson, 1962; Stone, 1957). Maladjustments in parent-child relations were much in evidence. The emotional climate in which the scientists grew up lacked the intimacy and warmth of close family relations. Ties with the parents were, for the most part, cold and distant. The scientists showed a high degree of independence of parental ties. As adults the scientists showed relatively little emotional involvement with their families, their emotional life being centered in their work.

Studies, for the most part, report that natural scientists and science students are more emotionally stable than those following other careers (Drevdahl, 1954; Eiduson, 1962; Knapp, 1963; Roe, 1952; Teevan, 1954; Terman, 1954). It was found that science students and scientists compared to the general population had less paranoid tendencies, less anxieties, and less fears. They would not be classified as neurotics because they showed so few symptoms of anxiety and tension. Scientists made relatively constant, habitual adjustments in the face of problems or conflict situations and dealt effectively with anxiety-producing situations rather than being overcome by them. Scientists were not inclined to changes in mood. One study (Gattell, 1963), however, found that scientists were more paranoid and anxious than the general college population from which they came.

Students who chose scientific careers were found to be more

reliable and responsible than those who chose other careers (Bello, 1954; Brandwein, 1955; Cattell and Drevdahl, 1955; Cooley, 1963). They showed a stronger sense of control and self-discipline, exhibiting responsibility towards others. Most, consciously tried to separate their judgment from their likes and would quickly change their opinion if proved wrong. Some investigators (Bello, 1954; Brandwein, 1955; Cattell and Drevdahl, 1955; Cooley, 1963; Stone, 1957) found a degree of nonconformity and independence among the science students, while one (Strauss, 1957) found that they were greatly influenced by other people.

The scientists and science students showed great interest in intellectual pursuits (Bello, 1954; Brandwein, 1955; MacCurdy, 1956; Roe, 1952; Stone, 1957). In comparison to the general population they were higher on strict, internalized and intellectualized standards. A major factor that motivated scientists to work was their curiosity. Scarcely any aspect of life could compete with their work for their emotional involvement. Such incentives as economic return, and social and professional status were of secondary importance to their work (Eiduson, 1962; Roe, 1952). Generally, their attitudes on economic issues tended toward liberal or radical points of view (Stone, 1957).

No definite conclusions can be drawn as to the relationships that exist between scores on interest tests and scores on other personality tests. Certain studies (Berdie, 1943; Darley, 1938) have shown that men scoring higher in the Scientific and Technical areas of interest tests were poorer adjusted socially, showed fewer social preferences, and were more limited socially than men in other interest groups. Some investigators

(Darley, 1938; Feather, 1950) found that natural scientists tended to have better home and emotional adjustments. On the other hand, one investigator (Tyler, 1945) found a general lack of relationship between interest scores and neurotic tendency, family adjustment, and emotional adjustment. Another investigator (Cottle, 1949) found little relationship between scores on interest inventories and personality inventories.

Consensus is lacking as to the esteem that science and scientists possess in North America. Studies done in the years 1956 to 1958 show considerable disagreement as to the image that students held of scientists. Two studies (Beardslee and O'Dowd, 1961; Mead and Metraux, 1957) reported that a majority of the students questioned had negative feelings about scientists. One investigation (Remmers and Radler, 1957) found that the students examined had mixed feelings toward science and scientists. It was found in two studies (Allen, 1959; National Association of Science Writers, 1958) that students, on the whole, did have a favorable attitude toward science and scientists.

CHAPTER IV

THE THEORY

A. REVIEW OF RELATED THEORIES

Theoretical Approaches to the Study of Vocational Choice

Various theoretical positions for the study of vocational choice have been set forth. Super and Bachrach (1957) list trait-and-factor theory, social systems theory, and personality theory. Each theoretical position represents differences in emphasis only. Each is viewed as a partial analytic system and none as a complete system by itself.

The trait-and-factor theory has been considered the classical approach. It concerns itself with identifying traits, such as intelligence, aptitudes, interests, earlier achievement, personality, and motivation, which are believed to determine the choice of and success in an occupation. These traits are considered to be predictors of vocational choice.

A variation of the classical approach described above holds that more considerations than personal traits must be considered in accounting for vocational choice. It emphasizes the functioning of factors which influence the sequence of vocational choices, each decision being the result of positive and negative influencing factors. These factors represent a combination of social (prestige, social status), economic (monetary rewards), and psychological forces (personality, intelligence) which result in a choice. Therefore individual traits and factors

should be treated as influences on a series of choices rather than as requirements for specific occupations.

The social systems approach to vocational development emphasizes the dynamic interaction of the individual with the social systems which impinge upon him. It has much in common with the cultural-psychodynamic approach summarized below. The individual can be viewed as occupying the center of several concentric circles which represent the social systems with which he interacts. The outer circle represents American cultural variables (Western values, North American mores, North American democracy). As we move inward we come to the subcultural forces which exert themselves on the individual (class values, customs, ethnic groupings, religious influences). The next circle represents community variables (voluntary associations). Finally, most directly impinging upon the individual are the organizational settings in which he is operating at any given time: family, school, and so on. Vocational development is seen essentially as the interaction between the individual and the social systems in which he operates.

Personality theories stress the personality structure of the individual and its development as determinants of vocational choice. Vocational development is seen as the result of the interaction of hereditary, environmental, and experiential variables. Approaches have been derived from the theories of psychoanalysis, self, interpersonal relations and needs, and a combination of cultural anthropology and psychodynamics.

Included in personality theories of vocational development is

the cultural-psychodynamic approach. This approach views vocational development as a result of the interaction between subcultural factors and personal psychodynamics. There is emphasis upon the social variables that are operative even before the individual is born. A value system is communicated to the individual by verbal symbolic means. The cultural-psychodynamic approach is the method of investigation upon which this study is based. The interaction of personality and cultural variables will be studied to gain a fuller understanding of factors motivating individuals to choose a career in science.

Riesman's Theory of Social Character

Introduction to the Riesman's Theory. Riesman (1961) distinguishes between the terms "social character" and "personality." He states that current social psychology uses the term "personality" to denote the total self, with its inherited temperaments and talents, its biological as well as its psychological components, its evanescent as well as its more or less permanent attributes. "Character," in one of its contemporary uses, refers to only a part of personality--that part which is formed not by heredity, but by experience. Character in this sense, is the more or less permanent socially and historically conditioned organization of an individual's drives and satisfactions--the kind of "set" with which he approaches the world and people.

"Social character" is that part of "character" which is shared among significant social relationships and which, as defined by most contemporary social scientists, is the product of the experiences of these

groups. The idea of social character permits us to speak, according to Riesman, of the character of classes, groups, regions, and nations.

Riesman expresses his typology of character in terms of what he calls the "mode of conformity" (Riesman, 1961, p. 6). It is clear that Riesman is referring to the way each society succeeds in producing individuals who follow its norms.

Riesman's Typology of Character. The three types of character that Riesman delineates are the tradition-directed, the inner-directed, and the other-directed. The tradition-directed man has virtually no consciousness of self. The person's psyche has no firm positions of its own. His wants and the way he acts are determined completely by the total social environment. The goals of such a person are fixed. The deviant who in our society might become an innovator or rebel becomes instead a shaman or sorcerer. He thus has the institutionalized right to deviancy but no opportunity to exert his will to change the society itself.

The second character type is named "inner-directed" because, according to Riesman:

. . . the source of direction for the individual is "inner" in the sense that it is implanted early in life by the elders and directed toward generalized but nonetheless inescapably destined goals (Riesman, 1961, p. 15).

The inner-directed person has a "strong sense of self"--of goals, desires, and aspirations. Social norms are not thought of belonging to the society but are considered the individual's own private and personal goals.

The force of tradition affects the inner-directed man. Traditions

limit his ends and inhibit his choice of means, but a splintering of tradition takes place. Even if the individual's choice of tradition is largely determined for him by his family, as it is in most cases, he cannot help becoming aware of the existence of competing traditions. He therefore possesses a somewhat greater degree of flexibility in adapting himself to ever-changing requirements. The scope for alternative courses of action is wide.

Riesman (1961) describes a psychological mechanism of the inner-directed person which he names "a psychological gyroscope" (Riesman, 1961, p. 16). This mechanism once set by parents and other authorities, keeps the inner-directed individual "on course" even when tradition, as responded to by his character, no longer dictates his moves. The inner-directed person becomes capable of maintaining a delicate balance between the demands put upon him by his life goal and the influences of his external environment.

The metaphor of the gyroscope cannot be taken literally. The inner-directed man is capable of learning from experience and is sensitive to public opinion in matters of external conformity. Signals from the outside can be received and utilized provided that they can be reconciled with the limited maneuverability that his gyroscope permits him.

Societies in which inner-direction prevails cannot be satisfied with behavioral conformity alone. In the tradition-directed society behavior is minutely prescribed. There is not the need for a highly developed individual character. The behavior required of the individual

is given in ritual and etiquette. Inner-directed societies present the individual with too many novel situations for behavioral conformity alone to suffice--though they are concerned with behavioral conformity. The problem of individual choice which was solved in the tradition-directed society by channeling choice through rigid social organization is solved through a rigid though highly individualized character.

The tradition-directed person hardly thinks of himself as an individual. It does not occur to him that he might shape his destiny in terms of personal, life-long goals. Nor does it occur to him that the destiny of his children might be separated from that of the family group. On the other hand, inner-directed individuals have a feeling of control over their own lives and see their children also as individuals with careers to make.

Riesman (1961) describes the other-directed character in the following way:

What is common to all other-directed is that their contemporaries are the source of direction for the individual--either those known to him or those with whom he is indirectly acquainted, through friends and through the mass media. This source is, of course, internalized in the sense that dependence on it for guidance in life is implanted early. The goals toward which the other-directed person strives shift with that guidance: it is only the process of striving itself and the process of paying close attention to the signals of others that remain unaltered throughout life. This mode of keeping in touch with others permits a close behavioral conformity, not through drill in behavior itself, as in the tradition-directed character, but rather through an exceptional sensitivity to the actions and wishes of others. . . . his need for approval and direction from others--and contemporary others rather than ancestors--goes beyond the reasons that lead most people in any era to care very much what others think of them. While all people want and need to be liked by some of the people some of the time, it is only the modern other-directed types who make this their chief source of direction and chief

area of sensitivity (Riesman, 1961, pp. 21-22).

Unlike the tradition-directed person, the other-directed character has a sense of his individual self, although this sense may be obscured by his anxiety to succeed in a time when "success" is defined exclusively as recognition by others and can no longer be equated with achievement of the relatively clear-cut goals pursued by the inner-directed man.

The three types can be distinguished by comparing the emotional control found in each type. Although the tradition-directed person feels the impact of his culture as a unit, it is mediated through the specific, small number of individuals with whom he is in daily contact. These expect not so much that he be a certain type of person but that he behave in the approved way. Therefore the sanction for behavior tends to be the fear of being shamed.

The inner-directed person, having early incorporated a psychic gyroscope which is set going by his parents, can receive signals later on from authorities who resemble his parents. He goes through life obeying this internal piloting. Therefore he is less independent than he seems. If he goes off course either in response to inner impulses or to the fluctuating voices of contemporary people, a feeling of guilt may result.

The inner-directed person is capable of great stability since the direction to be taken in life has been learned at home from a small number of people and since principles, rather than details of behavior, are internalized. The behavior of the inner-directed person is reinforced when others also have gyroscopes spinning at the same speed and

set in the same direction. Many inner-directed individuals can remain stable even when the reinforcement of social approval is not available.

The other-directed individual learns to respond to signals from a far wider circle than his parents. The family is not a closely knit unit to which the individual belongs but merely part of a wider social environment to which he early becomes attentive. In these ways the other-directed person resembles the tradition-directed person. Both live in a group milieu. The environment of the tradition-directed and other-directed person, however, differs radically. The border between the familiar and strange for the other-directed person has broken down. As the family continuously absorbs the strange and reshapes it, the strange becomes familiar. The border between the familiar and the strange is clearly marked in the societies depending on tradition-direction.

The tradition-directed person takes his signals from others, "but they come in a cultural monotone; he needs no complex receiving equipment to pick them up" (Riesman, 1961, p. 25). The other-directed person, on the other-hand, must be able to receive signals from far and near. There are many sources and the changes in the signals are rapid. A code of behavior is not internalized, but rather the elaborate equipment needed to attend to such messages and occasionally to participate in their circulation. In the other-directed person guilt-and-shame controls do survive, but one prime psychological lever of the other-directed person is a diffuse anxiety. "This control equipment, instead of being like a gyroscope, is like a radar" (Riesman, 1961, p. 25).

In the preface to the 1961 edition of The Lonely Crowd, Riesman

discusses the positive aspects of the other-directed person:

The other-directed person wants to be loved rather than esteemed; he wants not to gull or impress, let alone oppress, others but, in the current phrase, to relate to them; he seeks less a snob-bish status in the eyes of others than assurance of being emotionally in tune with them. He lives in a glass house, not behind lace or velvet curtains. (Riesman, 1961, p. xx).

In this edition Riesman points out the gains that have been made possible by the considerateness, sensitivity, and tolerance that are among the positive qualities of other-direction. There has been a tendency toward an enlargement of the circles of empathy beyond one's clan, beyond even one's class, and sometimes even beyond one's country. Not only is there a great psychological awareness of one's peers but a willingness to admit to the status of peer a wider range of people, whether in one's own immediate circle or vicariously through the mass media. The problem for people in America today is other people. The social and psychological concern of individuals has become enlarged because other people are more in number and, possibly, in heterogeneity than ever before. But other concerns, such as nature itself, the cosmos, the Deity, have retreated into the background or disappeared. The result is that aspects of character that were always in some sense available become more salient, and other aspects of character recede. Table I summarizes the agency of socialization, the factors governing behavior and the psychological mechanisms of conformity (Broom et. al. 1955, adapted from Riesman, 1950).

Riesman points out that since most of us value independence we are likely to prefer the inner-directed type and overlook two things. First, the inner-directed person is no less a conformist to others than

TABLE I

SOCIALIZATION AND MOLES OF CONFORMITY*

Social Character	Who Socializes	What Guides Behavior	Psychological Mechanism of Conformity
Tradition-directed	The class, the tribe, the village	Adherence to detailed norms of village life learned by directed observation	Shame: wrongdoing is a transgression against the group
Inner-directed	The parents	Adherence to general principles laid down early in life, with freedom for nonconformity within these limits	Guilt: wrongdoing is a violation of personal ideals
Other-directed	The peer group	Care-taking within particular situations; being fashionable and "in the know;" built in radar steers individual	Anxiety: the ultimate evil is being unloved and unapproved

* (Broom et al. 1955, adapted from Riesman, 1950)

the other-directed person. The voices to which he listens, however, belong to an older generation. Their cues have been internalized in his childhood. Second, the type of conformity indicated is only one, though the predominant mechanism of the inner-directed person. The latter is not characteristically insensitive to what his peers think of him. He may even be very opportunistic. The point is that he need not always react to other people as if they were merely stand-ins for his parents, but that he is somewhat less concerned than the other-directed person with continuously obtaining from contemporaries (or their stand-ins, the mass media) guidance, expectation, and approval.

There is no such thing as a society or a person completely dependent upon tradition-direction, inner-direction, or other-direction. Each of these modes of conformity is universal. The question is that of the degree to which an individual or a social group places reliance on one or another of the three mechanisms.

The change from Tradition-Direction to Inner- and Other-Direction.

Riesman makes the assumption that the years of childhood are of great importance in molding character. He assumes that childhood years cannot be understood in isolation from the structure of society. The structure of the society affects the parents who raise the children, as well as the children directly. It is on this premise that Riesman has built his theory of social character.

Riesman seeks to link certain social and characterological developments, as cause and effect, with certain population shifts in Western society since the Middle Ages. He states that since the Middle Ages it

seems reasonably well established that the curve of population growth in Western countries has shown an S-shape. The bottom horizontal line of the S curve represents that situation in which the total population does not increase or does so very slowly. The number of births equals the number of deaths, and both are very high. Such societies are said to be in the phase of "high growth potential," for if the very high death rate should be decreased the population would increase very rapidly. This is what happened in the West starting with the seventeenth century. It is represented by the vertical bar of the S. This is called the stage of "transitional growth," because the birth rate soon follows the declining death rate. The top horizontal bar of the S represents societies in the stage of "incipient population decline." The total population growth is small because both births and deaths are low. In the United States and other Western countries "incipient population decline" has not become "population decline" itself, and the birth rate has shown an uncertain tendency to rise again. But most demographers think that this is temporary. Riesman's theory is that each of the three different phases on the population curve represents a society that enforces conformity and molds social character in different ways. The tradition-directed person develops in the society of high growth potential. The society of transitional population growth typically develops inner-directed individuals and the society of incipient population decline typically develops other-directed individuals.

Riesman states that he is not concerned with making the detailed analysis that would be necessary before one could prove that a link

exists between population phase and character type. He states that his reference is as much to the complex of technological and institutional factors related to the development of social character as to the demographic facts themselves.

The type of social order in which tradition-directed individuals arise is relatively unchanging. The conformity of the individual tends to reflect his membership in a particular clan or caste. He learns to understand and appreciate patterns which have lasted for centuries. The important relationships of life may be controlled by careful and rigid etiquette which is learned by the young. The culture provides economic tasks, ritual, routine, and religion to occupy and to orient everyone. There is little energy directed toward finding new solutions to age-old problems such as in the area of agricultural technique or in the field of medicine. The society depends on family and kin organization.

Although the activity of the individual is determined by characterologically grounded obedience to traditions, the individual is highly prized and, in many instances, he is encouraged to develop his initiative, and within very narrow limits, his aspirations. Indeed, the individual in some primitive societies is far more appreciated and respected than in some sectors of modern society. In a society dependent on tradition-direction the individual has a well-defined functional relationship to other members of the group. If he is not killed, he "belongs"--he is not "surplus," as the modern unemployed are surplus, nor is he expendable as the unskilled are expendable in modern society. By the very virtue of

his "belonging," however, life goals that are his own in terms of conscious choice appear to shape his destiny only to a very limited extent.

In some societies certain individuals, especially if they belong to families of high status, are encouraged toward a degree of individuality from childhood. But since the range of choice even for high-status people is minimal, the apparent social need for an individuated type of character is also minimal. Riesman believes that it is probably accurate to say that character structure in these societies is very largely "adjusted," in the sense that for most people it appears to be in tune with social institutions.

This does not mean that the people are happy. The society to whose traditions they are adjusted may be a miserable one, in which there exists anxiety, sadism, and disease. Change in such a society is very slow.

In Western history the Middle Ages can be considered a period in which the majority were tradition-directed. The term tradition-directed, however, refers to a common element, not only among the people of pre-capitalist Europe, but also among such people as Hindus, Hopi Indians, Zulus, Chinese, North African Arabs, and Balinese.

The change in the relatively stable ratio of births and deaths, characteristic of the period of high growth potential, is both the cause and consequence of other profound social changes. Usually a decline takes place in mortality prior to a decline in fertility. There is then a period in which the population expands rapidly. The drop in the rate is due to such factors as improved sanitation, improved communications (the latter permitting governments to operate over a wider area and

also permitting easier transportation of food to areas of shortage from areas of surplus), the decline, of infanticide, cannibalism, and other inbred forms of violence. With improved methods of agriculture more people can be supported and these in turn produce still more people.

In Western history the society that emerged with the Renaissance and Reformation and that is only now vanishing illustrates the type of society in which inner-direction is the principal way of securing conformity. The society of inner-direction is characterized by increased personal mobility, a rapid accumulation of capital, and devastating technological shifts. There is rapid expansion in the production of goods and extensive expansion in exploration, colonization and imperialism. This society gives the individual greater choice and it demands greater initiative to deal with its new problems.

Riesman states that The Lonely Crowd (1961) does not explain how the inner-directed social character came about, but family structure seemed to be of decisive importance. The nuclear family makes possible the bringing up of children with very intense identifications with parental models, although, Riesman states that this alone is insufficient to account for the definiteness of set and conviction which is found in many inner-directed individuals. Riesman believes that the change from tradition-direction to inner-direction is in part a consequence of the institutions that inner-directed man conceived. One of these institutions was the free market.

As the birth rate began to follow the death rate downward societies passed into the period of incipient population decline. In this epoch are

found the other-directed persons. Fewer people work on the land, in the extractive industries, and in manufacturing. The hours of work are short and people may have material abundance and leisure. The hard enduringness and enterprise of the inner-directed types are not as necessary under the new conditions. Other people are more and more the problem rather than the material environment. The other-directed mode of conformity arises as the expanding population reaches its peak.

The "scarcity psychology" of many inner-directed people was socially adaptive during the period of heavy capital accumulation. Riesman states that in the epoch of other-direction there is a need for "abundance psychology" capable of "wasteful" luxury in order to make use of leisure and the surplus product. The alternative to this is the destruction of the surplus product in war. In the period of incipient decline the non-productive consumers, both the increasing number of old people and the diminishing number of young, form a high-proportion of the population. These need both the economic opportunity to be prodigal and the character structure that allows it.

Riesman's analysis of the processes that underlie the shift from inner- to other-direction focuses on production, and specifically on economic production. The individual turns to consumption when the solution of problems of production becomes built into the system, and the goals of production are no longer problematical for the individual:

. . . on the whole, contemporary society, especially America, no longer requires and rewards the old enterprise and the old zeal. . . . The invention and adoption of new improvements can be routinized, built into the system, so to speak, rather than into the men who run the system (Riesman, 1954, p. 104). . . .

In general, I think it can be said that many of the motives which were in earlier decades built into the character structure of individuals are now built into the institutional structure of corporate life (Riesman, 1954, p. 231).

The inner-directed person pioneered on the frontier of production whereas the other-directed is not just concerned with the consumption of goods, but of words in ages and personal relationships themselves, particularly those aspects that deal with "the minutiae of taste or speech or emotion which are momentarily 'best'" (Riesman, 1954, p. 105).

Education, leisure, and services go together with an increased consumption of words and images from the new mass media of communication. Societies in the phase of transitional growth increase the process of distributing words from urban centers. But in societies of incipient population decline "the flow becomes a torrent" (Riesman, 1961, p. 20). This process takes place everywhere in the industrialized lands. Increasingly, relations with oneself are mediated by the flow of mass communication.

For large numbers of people these developments lead to changes in the ways individuals achieve success. There is the requirement of more "socialized" behavior both for success and for marital and personal adjustment. With such changes come new practices in child-rearing. With the smaller families of urban life, and with the spread of "permissive" child care to an ever wider strata of the population, there is a relaxation of older patterns of discipline. As a result of these newer patterns the peer-group becomes much more important to the child. The parents do not make the child feel too guilty about the violation of inner standards. Rather the child is made to feel guilty for the failure

to be popular or otherwise to manage inadequately his relations with his peer-group. In addition, the pressures of the school and the peer-group are reinforced and continued by the mass media.

Tradition-Directed, Inner-Directed, and Other-Directed Character Training. The extended family and its environing clan or group is the major agency of character formation in societies dependent on tradition-direction. Models for imitation are likely to be the adult group as a whole rather than confined to the parents. The child does not face problems that are very different from those that his elders faced. What is imitated is behavior and specific traits such as bravery or cunning.

In the transitional growth phase of the population curve there are opportunities for social and geographic mobility. People begin to explore the new frontiers of production, colonization and intellectual discovery. Society no longer unequivocally states what one must do in order to conform. In this epoch the child becomes aware of competing sets of customs and competing paths of life. The wider possibilities and wants require a character which can follow rather generalized and more abstractly defined goals. Such a person must himself devise the appropriate specific means to gain general ends.

With the division of labor in the society of transitional growth increasing numbers of children can no longer take their parents' roles as models. While the parents in the stage of transition growth cannot be sure of what the adult working role and mode of life of their children will be, conformity to that role cannot be left to chance. To possess the drive that is required to fulfill demanding and ever more demanding

roles calls for greater attention to formal character training. The new situation created by increased social mobility results in children frequently having to be socialized in such a way as to be unfitted for their parents' roles, while being fitted for roles not yet fully determined. The drive that is instilled in children is to live up to ideals and to test their ability to be on their own by continuous experiments in self-mastery instead of by following tradition.

In a tradition-directed society to insure conformity much of the parent's effort is directed toward keeping the child from being a nuisance to the adult world. This task is regularly delegated to older brothers and sisters or to other adults. The child learns that to conform is the price of peace and he learns to appease or at least not to annoy those around him.

The inner-directed parent demands more than behavioral conformity of his child. He demands self-discipline. The inner-directed parent can do this because with the passing of the extended kinship family the parent has his children much more under his own undivided and intensive scrutiny and control. The inner-directed parent may unconsciously impose his demands on his children merely by being forceful, tense, and highly charged. Indeed, the inner-directed man is often incapable of casual relationships. Since he is preoccupied with his own concerns, he is worried about wasting time. Moreover, his relationship to people, including his own children, is affected by his continuing, character-conditioned need to test and discipline himself.

Inner-directed individuals feel throughout their life that their

characters should be worked on. The awareness of the self is the result of the fact that choice is no longer automatically provided by the society in which the individual lives. Under these conditions the individual must decide what to do himself. The feeling of personal responsibility, the feeling that he matters as an individual, apart from his family or clan, makes him sensitive to the signals emanating from his internalized ideal. If the ideal, as in the puritan, is to be "good" or, as in the child of the Renaissance, to be "great," the individual asks himself what he must do to fulfill this injunction. Little rest is available to those who ask themselves such questions.

The child is prepared for such questions by the relative uncomfotableness of the inner-directed homes, by the lack of indulgence and casualness in dealing with children. To be more precise, the child's character is such that he feels comfortable in an environment which, like his home, is demanding and which he struggles to master.

The expanding frontiers in the phase of transitional growth of population enables the inner-directed person to see industrial and commercial possibilities and to work with the zeal and the ruthlessness required by expanding frontiers. Societies in the phase of incipient population decline need neither such zeal nor such independence. Business, government, and the professions become highly bureaucratized. Advancement depends less on what one is and what one does than on what others think of one and how competent he is in manipulating others. The product that is now in demand is a personality.

The parents who are now increasingly in doubt as how to bring up

their children turn to other contemporaries for advice. They also look to the mass media. By their own anxiety they cannot help but show their children how little they depend on themselves and how much they depend on others. For inner-directed children the criteria of success were reasonably clear. But the other-directed child faces the demand of not only succeeding but also the problem of defining success.

With no definite goals toward which to aim the individual can only seek approval. Being granted approval is equated with making good. Since approval is granted by the peer group, it becomes all powerful. From experiences with his parents the child learns that nothing he possesses, whether it is his character, his possessions, family prestige, or achievement has intrinsic value. The worth of an object or a person lies in the effect it has on others. Therefore success comes from making friends who will give approval.

In the era of other-direction the influence of parents, grandparents, and siblings has decreased from that which they possessed in the era of inner-direction. With improved social and economic conditions the children have more material possessions. With smaller families children are less numerous. Since most children are raised to maturity, in contrast to the tradition-directed era when many were not, parents are more concerned with each child. Other-directed parents lack the self-assurance of their inner-directed counterparts. There is doubt as how to bring up children. As a result of such conditions, parents no longer feel that they are superior to their children. From the mass-media and their peers, children learn what the norm of parental behavior is and confront their parents

with the standards thus learned.

Parents still try to control their children, but now different methods are used. The other-directed parents lack the self-assurance of their inner-directed counterparts. They do not hold themselves up as examples. They feel guilty if they resort to severe corporal punishment or deprivations. There may be token spankings, but only in the lower classes is there harsh physical punishment. Other-directed parents try to manipulate their children through argument in the same manner. The tradition-directed child tries to please his parents. The inner-directed child fights or yields to his parents. The other-directed child manipulates his parents and in turn is manipulated by them.

There are different areas of concern between inner-directed parents and their children and other-directed parents and their children. The inner-directed parents forced their children to work, to save, to clean house, sometime to study, and sometimes to pray. Inner-directed parents who were less puritanical desired their boys to be manly, and their girls to be feminine and chaste. In the era of inner-direction such demands were logical. The large home could use enormous amounts of labor. The paths of work and study were believed to be the way to upward mobility.

In the era of other-direction there is no work in the home for the children to do. There are few younger children to be cared for and both husband and wife face the problem of leisure. Caring for the house is the wife's self-justification. Thus the issues between parents and

children concern areas other than work. Parents and children now argue over eating and sleeping time, the use of the family car, and about the friends with whom the children associate. In the era of other-direction parents find it more difficult to convince their children than did parents in the preceding era. In the phase of transitional growth parents could point to tasks around the home that required attention. In other-directed homes decisions must be made concerning the spending of money and the use of leisure time. One now has to look outside the home for direction. Both parents and children contend for their particular viewpoint, using radio, television, newspapers, and magazines as the bases for their position. The role of the parents is less important as compared to their role in the society of inner-direction.

B. CONTEMPORARY ATTITUDES TOWARD SCIENCE

There is greater awareness today of the importance of science and technology in our society than ever before. Because of this esteem for science it is postulated that some people who lack the interests of scientists are nevertheless choosing science as a career.

As evidence for the respect in which science is now held the following statements are presented.

Waterman (1957) discusses the present respect for science in the following terms:

In other words sputnik accomplished, in one bold stroke, what many of us have been trying slowly and laboriously to accomplish for a number of years, namely, to create in the minds of the American people an awareness of the tremendous importance of science and technology in the world today (Waterman, 1957, pp. 85-86). . . .

Fitzpatrick (1960) states that scientists and technicians have rather recently achieved a recognized status in the American culture.

Hurd (1961) reports that the Second Session of the Eighty-fifth Congress of the United States recorded 1,600 pages of testimony on the question of science and education for national defence. He also reports that the National Science Foundation in the United States has already spent millions of dollars in developing new science courses for high schools.

Schwab (1962) referring to science states that "nothing before in the history of this country (the United States) . . . has evoked such a concert of effort and attention" (Schwab, 1962, p. 4).

C. THEORETICAL FRAMEWORK

Definitions

Because the terms used in this dissertation have a variety of meanings, they are defined in order to avoid ambiguity. The terms are defined with reference to particular tests.

Scientific Careers refer to careers in engineering, chemistry, mathematics, and physics.

Interest is defined as having the likes and dislikes of those engaged in an occupation. Interest is measured by the Strong Vocational Interest Blank (Strong, 1959).

Extraversion is defined as a personality type characterized by the behavioral correlates of sociability, a love of people and social activity, a craving for action and excitement and a love of change.

The typical extravert is easy-going, optimistic, and carefree. He does not control his emotions rigidly and is not always reliable. This concept of Extraversion is measured by the Maudsley Personality Inventory (Eysenck, 1959).

The Sociable Extravert is the personality type conforming to the conception of extraversion which stresses strong social affinities and an ease in interpersonal relationships. In contrast, the impulsive extravert is the personality type conforming to a relative lack of super ego controls and a tendency to act on the spur of the moment. This concept of the Sociable Extravert is measured by the Maudsley Personality Inventory (Eysenck, 1959).

Introversion is defined as the personality type more or less diametrically opposed to Extraversion. The behavior of the typical introvert is quiet, retiring, reserved, introspective, and carefully controlled. The introvert does not like excitement, is seldom aggressive, and is reliable though somewhat pessimistic. This concept of Introversion is measured by the Maudsley Personality Inventory (Eysenck, 1959).

Social Adjustment refers to whether or not students are happy and comfortable when with groups of students or adults. Those who are well adjusted socially have a liking for others and are well-liked in return. In general, they have good social skills, converse easily and well, have acceptable manners, and conduct themselves appropriately in social situations. This concept of Social Adjustment is measured by the Minnesota Counseling Inventory (Berdie and Layton, 1957).

Family Adjustment indicates the relationships between the student and his family; whether or not there are conflicts or maladjustments in family relationships. This concept of Family Adjustment is measured by the Minnesota Counseling Inventory (Berdie and Layton, 1957).

Economic Considerations refer to the interest the individual has in the affairs of the business world: the production and consumption of goods, and the accumulation of tangible wealth. This concept of Economic Concerns is measured by the Study of Values (Allport et. al., 1960).

Systematization of Knowledge refers to the individual who takes a "cognitive" attitude, one who looks for identities and differences; one who divests himself of judgments regarding the beauty or utility of objects, and seeks only to observe and to reason. This concept of the Systematization of Knowledge is measured by the Study of Values (Allport et. al., 1960).

Other-Direction describes the other-directed individual in Riesman's typology of character explained in Chapter IV. It is measured by Kassarjian's Inner-Other Directed Scale (Kassarjian, 1962).

Theoretical Position

In order to explain an individual's choice of actions both personal and cultural variables must be examined. Cultural factors vary with time. Therefore, in explaining why an individual chooses a certain career, changing cultural forces must be considered. Today science and technology have evoked more attention and enjoy more esteem than ever before. The respect that science and scientists now have has been described by various individuals (Fitzpatrick, 1960; Hurd, 1961; Schwab, 1962; Waterman,

1957).

As a result of the newfound respect for science and technology, it would be expected that individuals whose actions are influenced by social considerations should be attracted to scientific careers. Such individuals may or may not have the attributes possessed by science students of an earlier time. It would be expected, certainly, that not all such individuals would have the interests and personality attributes that have been generally ascribed to scientists and science students. But by selecting those individuals who lack the interests of scientists as one group for investigation, the explanation that the individual chooses a scientific career because of his interests is eliminated. It can then be determined which other factors are motivating such individuals in their desire to follow a career in science.

A possible explanation for individuals who lack the interests of scientists choosing scientific careers might be found in personality variables such as introversion, poor social relations, and such other factors. From the description of scientists (Cattell, 1963; Eiduson, 1962; Roe, 1953a; Terman, 1954) it would appear that individuals who possess such traits might find a career in science attractive.

The other variable that may explain an individual's choice of a scientific career is the prestige that the individual perceives science and scientists to have. Riesman (1961) has described a character type which he has named "other-directed." The other-directed individual makes the approval of others his chief source of direction and chief area of sensitivity. It therefore follows

that those other-directed individuals who perceive a career in science to be socially desirable should wish to pursue a scientific career.

It is postulated that individuals who are lacking measured interest in scientific careers and who lack personality characteristics of scientists are motivated to choose a career in science because (1) they perceive a career in science as having social desirability, and (2) they are other-directed, which makes them susceptible to the opinions of others.

Hypotheses

The characteristics of scientists and science students who chose careers in science has been described in Chapter III. In the areas of family relationships, interest in intellectual pursuits, concern for economic returns, and emotional stability, there is more or less general agreement as to the characteristics possessed by those who chose scientific careers. However, consensus has not been reached as to the characteristics of scientists and science students in the areas of social relations and conforming behavior.

The characteristics that scientists have today and the characteristics that they possessed when they were science students were described in Chapter III. For the most part, those described were science students prior to 1957. In postulating characteristics that may explain an individual's choice of a scientific career various factors must be taken into consideration: (1) Why have contradictory results as to certain personality traits possessed by scientists and science students been obtained? (2) Has the newfound prestige that science and scientists

possess resulted in individuals choosing scientific careers who have characteristics unlike those possessed by science students in former years? (3) Can the prestige that science and scientists enjoy explain why certain individuals who lack measured interest in science are choosing scientific careers? (4) Can Riesman's theory of Inner and Other-Directedness help to explain why individuals who lack measured interest in science wish to enter scientific careers?

Two groups of students aspiring to become scientists are studied:
Group I: That group of students having the likes and dislikes of those now practising science;
Group II: That group of students who do not have the likes and dislikes of those now practising science.

With regard to these two groups, the following hypotheses are made:

Major Hypothesis I: Those choosing scientific careers who lack the interests of scientists do so due to the nature of their personality traits and because they perceive scientists to have social desirability.

The experimental hypotheses derived from the preceding major hypothesis are as follows:

1. Those choosing scientific careers who lack the interests of scientists will be more other-directed than those choosing scientific careers who have the interests of scientists.

2. Those choosing scientific careers who lack the interests of scientists will perceive science and scientists to have social desirability.

3. Those choosing scientific careers who lack the interests of

scientists will score higher on conformity than those choosing scientific careers who have the interests of scientists.

4. The social extraverts as described by Eysenck (1963) will correlate with the other-directed individuals.

Major Hypothesis II: Those choosing scientific careers who have the interests of scientists will show more nearly the other personality traits generally ascribed to scientists than those lacking the interests of scientists.

The experimental hypotheses which are derived from Major Hypothesis II follow:

1. Those choosing scientific careers who have the interests of scientists will show less neurotic tendency than those choosing scientific careers who lack the interests of scientists.

2. Those choosing scientific careers who have the interests of scientists will be more introverted than those choosing scientific careers who lack the interest of scientists.

3. Those choosing scientific careers who have the interests of scientists will not be as well socially adjusted as those choosing scientific careers who lack the interests of scientists.

4. Those choosing scientific careers who have the interests of scientists will not be as well adjusted to their family as those choosing scientific careers who lack the interests of scientists.

5. Those choosing scientific careers who have the interests of scientists will be less interested in economic considerations than those choosing scientific careers who lack the interests of scientists.

6. Those choosing scientific careers who have the interests of scientists will be more interested in systematization of knowledge than those choosing scientific careers who lack interest in science.

CHAPTER V

EXPERIMENTAL DESIGN AND PROCEDURES USED

A. THE SAMPLE

The experimental population consisted of grade twelve male students ranging in age from sixteen to twenty-one years. Students drawn from the Edmonton Public and Separate School Systems were used in the investigation. The principal of each school selected students who had indicated that they planned to enter a career in engineering, chemistry, mathematics, or physics. The students were examined in one testing session. Students from the following schools participated in the study: Bonnie Doon Composite High School, Eastglen Composite High School, Jasper Place Composite High School, O'Leary High School, St. Francis Xavier High School, St. Joseph's High School, St. Mary's High School, and Queen Elizabeth Composite High School. Two hundred students were tested. The fifty-four highest and the fifty-four lowest scoring students on the physical science scales of the Strong were studied as two separate groups.

B. DESCRIPTION OF THE TESTS

Strong Vocational Interest Blank

The Strong (Strong, 1959) contains four hundred items listing school subjects, occupations, hobbies, kinds of people, and similar items, to which persons respond for the most part by expressing Liking, Dislike, or Indifference. In the scoring process an individual's responses are compared with the known responses of persons who have been successful in

various occupations. A score on an occupational scale of the Vocational Interest Blank expresses the extent to which a person possesses likes and dislikes distinguishing members of one occupational group from men in general.

An 18-year follow-up of former Stanford University students (Strong, 1955) revealed that the chances are 50-50 that a man will enter an occupation on which he has a B rating. A scores (raw scores from 55 to 70) indicate an expectancy ratio of 88, that is, the chances are 88 to 12 that the individual will complete his training in the occupation in which he scores from 55 to 70. A-scores (raw scores from 45 to 54) have an expectancy ration of 74. B+(raw scores from 40 to 44), B (raw scores from 35 to 39), B- (raw scores from 30 to 34), and C (raw scores below 30) have ratios, respectively of 62, 49, 36, and 17.

Comparing odd-versus even-numbered items on the Vocational Interest Blank, the average coefficient or reliability of thirty-six revised scales for men is .877, as based on the records of 285 Stanford seniors. Only in the case of the certified public accountant scale (.727) does the coefficient fall below .80. The median correlation of scores for eleventh-grade boys over two and a third years is .81; for college freshmen over one year it is .88, and over nineteen years, .72.

Maudsley Personality Inventory

The Maudsley Personality Inventory (Eysenck, 1959) consists of forty-eight items, twenty-four of which are designed to measure Extraversion. Theoretically the dimensions of Extraversion and Neuroticism are independent. It was found, using twenty different samples in both

England and America that the correlation coefficient was found to be about $-.15$. Coefficients of reliability are reported which range from $.85$ to $.90$ for the Extraversion Scale and from $.80$ to $.90$ for the Neuroticism scale. These coefficients were obtained using both the Kuder-Richardson and split-half methods. With reference to concurrent validity, a correlation of $.92$ obtained between the Extraversion Scale of the Maudsley Personality Inventory and the Guilford C scale of the Guilford-Zimmerman Temperament Survey. The Cattell Neuroticism and Introversion Scales correlate $.34$ and $.53$ (forms A and B), and $.65$ and $.67$ (forms A and B) with the corresponding Maudsley Scales.

On 1,500 American students the mean and standard deviation of the Neuroticism Scale was 20.91 and 10.69 respectively; and the mean and standard deviation of the Extraversion Scale was 28.53 and 8.28 respectively.

Sociability-Impulsiveness Scale

The Sociability-Impulsiveness Scale (Appendix B) consists of thirty-seven items selected from the sixty-six listed in the research report by Eysenck and Eysenck (1963). The criterion for selection of the items was a minimum factor loading of $.25$ on the Extraversion factor. This yielded twenty items pertaining to sociability and seventeen items relevant to impulsiveness. Eysenck and Eysenck (1953) describe Sociability and Impulsiveness as second order factors of Extraversion. They report a correlation of these factors of 0.50 . The items were designed to distinguish two different kinds of extraverts: the sociable and the impulsive. The impulsive extravert conforms to the European conception

of Extraversion which stresses a relative lack of super ego controls and a tendency to act on the spur of the moment. The Sociable Extravert conforms to the American conception of Extraversion which stresses strong social affinities and ease in interpersonal relationships.

Minnesota Counseling Inventory

The Minnesota Counseling Inventory is based upon the Minnesota Personality Scale (Darley and McNamara, 1941) and the Minnesota Multiphasic Personality Inventory (Hathaway and McKinley, 1943). The validity of the Minnesota Counseling Inventory was determined in the following manner. Over six hundred high school teachers nominated students best conforming to certain detailed descriptions of behavior. The descriptions included statements considered symptomatic of the behavior of people who would be rated as possessing or lacking the psychological variables represented by the scales. Approximately twenty thousand students completed both the Inventory and a personal data sheet. A series of item analyses were conducted and each item was evaluated in relation to the types of students nominated by the teachers and ratings of the students by school social workers, counselors, principals, school nurses, and others in the schools. On the basis of these analyses, the best items were selected and incorporated into the 355 items in the Inventory.

Coefficients of correlation between scores on odd-and even-numbered items, corrected by the Spearman-Brown formula based on a sample of two hundred grade eleven and twelve boys are as follows: Family Relationships: 0.86; Social Relationships: 0.94; Conformity: 0.56. Based

on a sample of one hundred and fifteen boys in grade twelve the test-retest coefficients with an interval of three months between testing are as follows: Family Relationships: 0.84; Social Relationships: 0.86; Conformity: 0.73. Table II shows the intercorrelations among the scales of the Counseling Inventory that have been used in the study.

Students with low scores on the Family Relationships scale (Berdie and Layton, 1957) usually have friendly and healthy relationships with parents, and with brothers and sisters. It is likely that they receive much affection in their home and feel much affection toward members of their families. Such individuals spend much time at home and participate in activities with their families.

High scores are usually obtained by students who have difficulties with their parents or siblings. Such students usually believe that their parents are unreasonably strict and demand too much of them. These students avoid spending more time at home than is absolutely necessary and often express a desire to leave home.

Scores on the Social Relationships scale indicate the nature of the students' relations with other people. Low scores are characteristic of gregarious, socially mature individuals. They enjoy talking with others and are interested in the conversation of others. Such individuals are often the ones who introduce people to one another.

High scores indicate socially inept or under-socialized persons. They often seem to be unhappy and uncomfortable when with groups of students or adults. They do not enjoy associating or talking with other people. Others do not derive much satisfaction from being with them.

TABLE II

INTERCORRELATIONS AMONG SELECTED DIAGNOSTIC SCALES OF THE
MINNESOTA COUNSELING INVENTORY FOR GRADES ELEVEN AND TWELVE

SCALE	BOYS (N=200)		
	FR	SR	C
Family Relationships (FR)	1.00		
Social Relationships (SR)	.35	1.00	
Conformity (C)	.64	.14	1.00

The scores on the Conformity Scale indicate the type of adjustment a student makes in those situations requiring conforming or responsible behavior. Students with low scores are reliable. They conform to behavior codes. Such students understand the need for social organization. They cause little disturbance in school, practically never repeat an offense, and usually complete assignments on time.

Students with high scores are individualistic and self-centered. They are likely to be irresponsible, impulsive, and rebellious. Often they break rules repeatedly, even though they verbally acknowledge their actions to be wrong.

Study of Values

The aim of the Study of Values (Allport, Vernon, and Lindsey, 1960) is to measure the relative prominence of basic interests or motives in personality. The classification is based upon Eduard Spranger's Types of Men (1928) which puts forth the theory that the personalities of men are best known through a study of their values or evaluative attitudes. The Test consists of 120 questions having two alternative answers in Part I and four alternative answers in Part II. The subject records his preferences numerically.

The Theoretical and Economic scales are used in the study. Those who score high on the Theoretical scale have their dominant interest in the discovery of truth. The interests of the theoretical man are empirical, critical, and rational. He is an intellectual. His chief aim in life is to order and systematize his knowledge.

Those scoring high on the Economic scale are characteristically interested in what is useful. This is a very practical individual and conforms well to the prevailing stereotype of the usual American businessman. He is interested in what is practical. For example, he wants education to be practical, regarding unapplied knowledge as waste. In his relations with people he is more likely to be interested in surpassing them in wealth than in dominating them or in serving them. In his personal life he is likely to confuse luxury with beauty.

The Theoretical scale gives a split-half reliability of .84 and the Economic scale gives a split half reliability of .93. After an interval of one month the repeat reliability for the Theoretical and Economic scales was .87 and .92 respectively. After an interval of two months the repeat reliability for the Theoretical and Economic scales was .85 and .84 respectively. Using a heterogeneous sample of one hundred male and one hundred female subjects the Theoretical and Economic scales were found to correlate $-.22$.

Kassarjian's Test of Inner-Other Directedness

Kassarjian's (1952) test (Appendix B) of Inner-Other-Directedness was developed by borrowing directly from the descriptions employed by Riesman (1961). In most instances, the items were confined to areas covered by Riesman, and the content of the questions was often taken from descriptions given to depict a typical situation in which inner-and other-directed people would be clearly distinguishable.

The Inner-Other-Directed test consists of thirty-six items each of which is scorable along a five-point continuum from other-to inner-

directedness. For any individual the possible range of scores is from 0 (complete other-direction) to 144 (complete inner-direction), with 72 being considered the dividing point between inner-and other-directedness. Minus 2 is assigned to any strongly other-directed answer and plus 2 to any completely inner-directed reply. Zero means that the individual was not able to make a decision, thus falling between inner-and other-directedness. To avoid negative total scores 72 is added to the sum of the individual item scores.

Technical data regarding the test follows. Only items which individuals repeatedly answered over all the possible five points and which were of statistically significant (.05 level of confidence) internal consistency as determined by item analysis were retained. Individual item reliability was checked by the test-retest method and evaluated by means of tetrachoric correlations coefficients. Correlations ranged from .32 to .94 with only one item below .40; 24 items correlated .70 or higher. The test-retest method on a sample of 52 undergraduate students over a four-week interval yielded a reliability coefficient of .85.

Validity was determined by comparing scores on the Inner-Other-Directed Scale and reports on actual aspects of behavior. Riesman maintained that inner-and other-directed persons would tend to behave differently in various areas of their life, such as hobbies, sports and social life. A questionnaire was administered simultaneously with the Inner-Other-Directed Scale and perfected in the pilot studies. The questionnaire, in its final form, yielded ten measures of behavior.

The areas included in the questionnaire were: hobbies, sports, use of free time, frequency of attendance at parties and social engagements, size of party preferred, last three books read, membership in organizations and clubs, aspirations in life, things not aspired to, and three most valued "personality aspects." Scoring criteria were developed from Riesman's writings. Scoring was done on a five point criteria. Satisfactory correlations were obtained between the questionnaire concerning aspects of behavior and the Inner-Other-Directed Scale.

In order to establish inner-other-directedness as a distinctive psychological variable and apart from personality characteristics resembling the social character types, the F-Scale of the California Authoritarian Personality Study and the SI-Scale of the MMPI were administered to a sample of fifty-two students together with the Inner-Other-Directed Scale. It was found that the Inner-Other-Directed Scale did not measure those factors tapped by the F-scale (Pearson $r = .005$) and the correlation of .17 between the SI-scale and Inner-Other-Directed scale was not statistically significant.

C. DETERMINATION OF THE SOCIAL DESIRABILITY THAT THE INDIVIDUAL PERCEIVES SCIENCE TO HAVE

In order to ascertain if individuals choosing scientific careers perceive a career in science as being socially desirable, the following instructions were given to the subjects:

Write a paragraph explaining whether or not you look up to scientists. In your paragraph state whether or not you believe scientists and mathematicians enjoy prestige in our society.

The replies were judged by two raters as to whether or not the students believed that scientists are looked up to and enjoy prestige. Per cent agreement between the judges was calculated as follows:

$$\text{Per cent agreement} = \frac{\text{number of agreements}}{\text{total possible number of agreements}} \times 100$$

CHAPTER VI

RESULTS AND ANALYSIS OF THE DATA

Chapter VI presents the statistical procedures used in the dissertation, the results, and the analysis of the results. Both univariate and multivariate statistical techniques are used in the analysis.

A. STATISTICAL TECHNIQUES EMPLOYED

In the present investigation the t-test of significance, the Pearson product-moment correlation coefficient, and the multiple coefficient of correlation are employed. The t-test is based upon a structural model which assumed that $\sigma_a^2 = \sigma_b^2$. The t-test, however, is robust; that is, moderate departures from the hypothesis that $\sigma_a^2 = \sigma_b^2$ do not seriously affect the accuracy of the decisions reached by means of the t-test. A test of the hypothesis that

$$\sigma_1^2 = \sigma_2^2 = \dots = \sigma_k^2$$

is one given by Hartley (Winer, 1962, p. 93). When n is constant for all the k treatments in an experiment, this hypothesis may be tested by means of the statistic

$$\begin{aligned} F_{\max} &= \frac{\text{largest of } k \text{ treatment variances}}{\text{smallest of } k \text{ treatment variances}} \\ &= \frac{s^2_{\text{largest}}}{s^2_{\text{smallest}}} \end{aligned}$$

The parameters of the sampling distribution of the F_{\max} statistic are k , the number of treatments, and $n-1$, the degrees of freedom for each of the degrees of freedom for each of the treatment class variances. If the

observed F_{\max} is greater than the tabled value associated with an α -level test, then the hypothesis of homogeneity of variance is rejected.

Where the population variances are unequal, the significance of the difference between means may be determined by the Welch method (Ferguson, 1959, p. 145). The method proposed by Welch requires the calculation of a t value by dividing the difference between means by their standard error. This value is then referred to the table of t using the following formula for the number of degrees of freedom:

$$df = \frac{(s_{\bar{x}_1}^2 + s_{\bar{x}_2}^2)}{(s_{\bar{x}_1}^2)^2 / (N_1 + 1) + (s_{\bar{x}_2}^2)^2 / (N + 1)}$$

The statistical technique of multiple linear regression, in combination with computer programs to do the actual calculations, is a powerful tool in the investigation of relationships among variables, categorical or continuous, and a criterion. The multiple regression equation is used mainly for two purposes: (1) analysis and (2) prediction. In the present investigation multiple linear regression is used for analysis.

Starting with a set of n predictors X_i , $i=1$ to n , and a criterion y , the general procedure is to assume a linear model of the form

$$\hat{y}_1 = a_0 + a_1x_1 + a_2x_2 + \dots + a_nx_n \quad (1)$$

where \hat{y}_1 is the predicted criterion on the basis of the n predictors weighted by the numbers a_0, a_1, \dots, a_n . The weights are chosen to minimize the error sum of squares

$$q = \sum_{i=1}^N (y - \hat{y}_1)^2$$

where N is the number of subjects.

Categorical data can be handled by setting $X_i = 1$ if a subject is a member of category i and $X_i = 0$ if not.

The product moment correlation R_1 between the observed and predicted criterion is a measure of the goodness of fit of \hat{y} to y . Its square, called the squared multiple correlation (or RSQ), represents the variance of the criterion that is predicted by the model.

In order to investigate the effect of one predictor, say, X_p , in the presence of the others, we write a second linear model similar to equation (1) but excluding X_p :

$$y_2 = a_0 + a_1 x_1 + \dots + a_{p-1} x_{p-1} + a_{p+1} x_{p+1} + \dots + a_n x_n. \quad (2)$$

This equation can be called the restricted model, while referring to (1) as the full model. The restricted model has a squared multiple correlation of R_2^2 , less than R_1^2 .

An F-test can be made to determine if variable X_p is a significant predictor in the presence of the other variables:

$$F = \frac{(R_1^2 - R_2^2) / df_1}{(1 - R_1^2) / df_2}$$

where $df_1 = p_1 - p_2$, the degrees of freedom of the numerator, and $df_2 = N - p_1$, the degrees of freedom of the denominator; and p_j is the number of independent weights in model j (including a_0).

The PERSUB program (Bottenberg and Ward, 1963) permits this to be handled by a computer.

B. SCORES ON THE PSYCHOLOGICAL TESTS

The scores of the fifty-four subjects who demonstrated the highest interest in physical science careers on the Strong and the scores of the fifty-four subjects who showed the least interest in physical science careers on the Strong are given in Appendix A. The high interest group had a mean score on the physical science scales of 175.6 and the low interest group had a mean score of 71.7.

The scores of the subjects on the other personality tests are also given in Appendix A. The means, standard deviations, and t-tests of significance for scores obtained on Kassarjian's Inner-Other-Directed Scale, the Minnesota Counseling Inventory, the Maudsley Personality Inventory, and the Study of Values are shown in Tables III, IV, V, and VI respectively.

C. RATINGS ON THE PARAGRAPHS DESCRIBING THE SOCIAL DESIRABILITY OF SCIENCE AND SCIENTISTS

The paragraphs written by the students choosing careers in the physical sciences were judged by two raters as to whether or not the individual perceived a career in science as being socially desirable. One rater was the investigator, with a background in Science and Education. The other rater was a graduate student at the University of Alberta completing the Ph.D. degree in Educational Psychology, and having practised as a Clinical Psychologist for eleven years. The agreement between the two raters, calculated according to the formula given on page 85 of this thesis was 96.4 per cent. On the paragraphs on which the two raters agreed, it was found that 92.4 per cent of the students scoring low on the Strong and 88.4

TABLE III

STATISTICAL SUMMARY OF THE SCORES OBTAINED ON KASSARJIAN'S
INNER-OTHER DIRECTED TEST BY THE GROUPS SCORING LOW
AND HIGH ON THE STRONG VOCATIONAL INTEREST BLANK

t-Test	Variable	Low Strong		High Strong		t	Significance ¹
		Mean	SD	Mean	SD		
1.	Inner-Other Directedness	61.37	9.79	81.69	16.26	7.79	$p < .0005$

¹ Indicates the larger mean is greater than the smaller mean at the level of probability shown.

df= 89, using the Welch Correction

TEST FOR HOMOGENEITY OF VARIANCE

t-Test	F	df	Significance
1.	2.77	53 and 53	$p < .0005$

TABLE IV

STATISTICAL SUMMARY OF THE SCORES OBTAINED ON THE MINNESOTA
COUNSELING INVENTORY BY THE GROUPS SCORING
LOW AND HIGH ON THE STRONG VOCATIONAL
INTEREST BLANK

t-Test	Variable	Low Strong		High Strong		t	Significance
		Mean	SD	Mean	SD		
2.	Family Relationships	10.80	5.78	10.33	7.36	0.36	NS
3.	Social Relationships	17.33	9.02	25.33	12.10	3.87	$p < .0005^1$
4.	Conformity	13.57	3.95	11.50	3.90	2.72	$p < .005^1$

¹ Indicates the larger mean is greater than the smaller mean at the level of probability shown.

df = 106

TEST FOR HOMOGENEITY OF VARIANCE

t-Test	F	df	Significance
2.	1.62	53 and 53	NS ²
3.	1.80	53 and 53	NS ²
4.	0.10	53 and 53	NS ²

² Indicates the difference between the variances is not significant at the .02 level of probability.

TABLE V

STATISTICAL SUMMARY OF THE SCORES OBTAINED ON THE MAUDSLEY
PERSONALITY INVENTORY BY THE GROUPS SCORING LOW AND
HIGH ON THE STRONG VOCATIONAL INTEREST BLANK

t-Test	Variable	Low Strong		High Strong		t	Significance
		Mean	SD	Mean	SD		
5.	Extraversion	28.35	8.48	25.04	10.34	1.81	$p < .05^1$
6.	Neuroticism	21.74	8.70	21.20	10.34	0.29	NS

¹ Indicates the larger mean is greater than the smaller mean at the level of probability shown.

df= 106

TEST FOR HOMOGENEITY OF VARIANCE

t-Test	F	df	Significance
5.	1.49	53 and 53	NS ²
6.	1.41	53 and 53	NS ²

² Indicates the difference between the variances is not significant at the .02 level of probability.

TABLE VI

STATISTICAL SUMMARY OF THE SCORES OBTAINED ON THE STUDY OF
VALUES BY THE GROUPS SCORING LOW AND HIGH ON THE
VOCATIONAL INTEREST BLANK

t-Test	Variable	Low Strong		High Strong		t	Significance
		Mean	SD	Mean	SD		
7.	Economic Concerns	42.54	8.81	42.69	7.97	.091	NS
8.	Theoretical (Systematization of Knowledge)	41.19	6.60	48.78	7.69	5.46	$p < .0005$ ¹

¹ Indicates the larger mean is greater than the smaller mean at the level of probability shown.

df= 106

TEST FOR HOMOGENEITY OF VARIANCE

t-Test	F	df	Significance
7.	1.22	53 and 53	NS ²
8.	1.36	53 and 53	NS ²

² Indicates the difference between the variances is not significant at the .02 level of probability.

per cent of the students scoring high on the Strong perceived a career in the physical sciences to be socially desirable.

D. STATISTICAL ANALYSIS OF THE DATA

The statistical differences between the groups scoring low and high on the Strong Vocational Interest Blank on the measures of Inner-Other Directedness, Family Relationships, Social Relationships, and Systematization of Knowledge or Theoretical were tested by the univariate t-test. Homogeneity of variance was tested using the F_{\max} test. The results of the t-tests and the tests for homogeneity of variance are summarized in Tables III to VI.

The Pearson product-moment coefficients of correlation were calculated for all the variables and are shown in Appendix C. The Pearson product-moment coefficients of correlation examining the inter-relationships between Inner-Other Directedness and the various dimensions of Extraversion are shown in Table VII.

Table VIII summarizes the multivariate analyses employed in the investigation. In order to determine the variance that is accounted for by the variables employed in the investigation, the squared multiple correlation coefficient of the unrestricted model was calculated. It is shown in Table VIII labeled as "None" under the heading "Variable Partialled Out." To discover the variance that each variable accounted for, or the relative contributions of the different variables, the squared multiple correlation coefficients of restricted models were

TABLE VII
CORRELATION MATRIX FOR OTHER-DIRECTEDNESS, EXTRAVERSION,
SOCIABLE-EXTRAVERSION, AND IMPULSIVE EXTRAVERSION

N=108 Variables				
	1	2	3	4
1. Other-Directedness	1.00	.266	.409	.294
2. Extraversion		1.00	.635	.382
3. Sociable Extraversion			1.00	.327
4. Impulsive Extraversion				1.00

TABLE VIII

THE SQUARED MULTIPLE CORRELATION COEFFICIENTS SHOWING THE
VARIANCE CONTRIBUTED BY EACH FACTOR

Variable Partialled Out	Proportion of Variance Contributed (RSQ)	Significance (F-Test)
None	.472	
Other-Directedness	.297	0.001
Family Relationships	.464	0.211
Social Relationships	.458	0.108
Conformity	.460	0.134
Neuroticism	.467	0.348
Extraversion	.469	0.479
Systematization of Knowledge	.422	0.003
Economic Concerns	.470	0.566

df= 1 and 99

calculated. The variable partialled out in each case is shown in Table VIII. The F-test, to determine which variables are significant predictors in the presence of the other variables, is also shown in Table VIII. The statistical analysis of the data was done by the IBM 7040 computer at the Computing Center of the University of Alberta.

The t-Tests

Of the two hundred students examined who desired to become physical scientists fifty-four were selected who lacked interests of scientists and fifty-four were selected who possessed interests of scientists. The students who did not demonstrate the interests of scientists were found to be more Other-Directed than the students who possessed the interests of scientists. The difference is highly statistically significant, p being less than .0005 (Table III). The group having the interests of scientists and scoring higher on Inner-Directedness showed greater variability on the Inner-Other Directed Scale than the group lacking the interests of scientists and scoring higher on Other-Directedness. The difference is statistically significant at the .0005 level (Table III).

On two of the three variables measured by the Minnesota Counseling Inventory significant differences were found. No significant difference was found between the groups scoring low and high on the Strong Vocational Interest Blank on the measure of Family Relationships (Table IV). It was found that the group scoring low on the Strong physical science scales (and Other-Directed) scored lower on Social Relationships than the

group scoring high on the Strong physical science scales (and Inner-Directed). The difference is highly significant, p being less than .0005 (Table IV).

The group scoring lower on the physical science scales of the Strong scored higher on the Conformity measure (a high score indicates lack of conformity to rules) of the Minnesota Counseling Inventory than the group scoring high on the physical science scales of the Strong (Table IV). For the variables measured by the Minnesota Counseling Inventory the differences in the variances between the groups scoring high and low on the physical science scales of the Strong is not statistically significant (Table IV).

With the Maudsley Personality Inventory no significant difference was found on the variable of Neuroticism between the groups scoring low and high on the Strong Vocational Interest Blank. The two groups showed significant differences on the Extraversion scale, the group scoring lower on the Strong physical science scales being more extraverted than the group scoring high on the Strong physical science scales. The difference is significant at the .05 level (Table V). For both variables measured by the Maudsley Personality Inventory, homogeneity of variance for the groups scoring high and low on the physical science scales of the Strong was achieved.

The group of students possessing interests of physical scientists scored higher on the Theoretical variable of the Study of Values than those students lacking the interests of scientists. The difference is highly significant, p being less than .0005 (Table VI). There is no

significant difference between the students having the interests of scientists and those lacking such interests on the variable measuring Economic Concerns on the Study of Values. For both variables measured by the Study of Values, homogeneity of variance for the groups scoring high and low on the Strong was reached (Table VI).

The Pearson Product-Moment Coefficients of Correlation

The Pearson product-moment coefficients of correlation were calculated between scores on the Inner-Other-Directed Scale and the various dimensions of Extraversion (Table VII). The Pearson product-moment coefficient of correlation between Other-Directedness and Extraversion is .266; between Other-Directedness and Impulsive Extraversion is .294; and between Other-Directedness and Sociable Extraversion is .409. The Pearson product-moment coefficient of correlation between Extraversion and Impulsive Extraversion is .382; and between Extraversion and Sociable Extraversion is .635. The Pearson product-moment coefficient of correlation between Sociable Extraversion and Impulsive Extraversion is .327.

The Multivariate Analyses

The squared multiple correlation coefficients (Table VIII) show that 47.2 per cent of the variance has been accounted for. The two variables that explain most of the variance are the measures of Inner-Other Directedness, measured by Kassarjian's Inner-Other Directed Scale and the measure of Systematization of Knowledge or Theoretical measured by the Allport, Vernon, and Lindzey Study of Values. When the variable Other-Directedness is partialled out only 29.7 per cent of the variance is

explained. This variable therefore accounts for 17.5 per cent of the variance. When the variable Systematization of Knowledge is partialled out, 42.2 per cent of the variance is explained. It therefore accounts for 5.0 per cent of the variance. The remaining variables, which explain 24.7 per cent of the variance follow. They are listed in descending order of the proportion that each contributes to the explained variance: Social Relationships, Conformity, Family Relationships, Neuroticism, Extraversion, and Economic Concerns. The significant predictor in the presence of the other variables are the factors Inner-Other Directedness and Systematization of Knowledge. The variable Inner-Other Directedness is significant beyond the .001 level of probability, and the variable Systematization of Knowledge is significant beyond the .003 level of probability.

Comparison of the Findings with the Norms of the Psychological Tests

The variables of Neuroticism, Economic Concerns, and Family Relationships did not differentiate either the group possessing the interests of scientists or the group lacking the interests of scientists from the norming populations of the psychological tests measuring these variables (Tables IX, X, and XI).

The group scoring low on the Strong scored lower at the .005 level of significance on the variable of Systematization of Knowledge than the norming population of the Study of Values (Table XII). The group scoring high on the Strong scored higher at the .0005 level of significance on the variable of Systematization of Knowledge than the norming

TABLE IX

COMPARISON OF SCORES ON THE VARIABLE OF NEUROTICISM OBTAINED BY THE GROUPS SCORING LOW AND HIGH ON THE STRONG VOCATIONAL INTEREST BLANK WITH THE NORMING POPULATION OF THE MAUDSLEY PERSONALITY INVENTORY

t-Test	Low Strong		Norming Population		t	df	Significance
	Mean	SD	Mean	SD			
1.	21.74	8.70	20.91	10.69	0.68	1,552	NS ¹
	High Strong		Norming Population		t	df	Significance
	Mean	SD	Mean	SD			
2.	21.20	10.34	20.91	10.69	0.20	1,552	NS ¹

¹ Indicates the larger mean is not significantly greater than the smaller mean at the .05 level of probability.

TEST FOR HOMOGENEITY OF VARIANCE

t-Test	F	df (greater mean square listed first)	Significance
1.	1.51	1,499 and 53	NS ²
2.	1.07	1,499 and 53	NS ²

² Indicates the difference between the variances is not significant at the .02 level of probability.

TABLE X

COMPARISON OF SCORES ON THE VARIABLE OF ECONOMIC CONCERNS
OBTAINED BY THE GROUPS SCORING LOW AND HIGH ON
THE STRONG VOCATIONAL INTEREST BLANK
WITH THE NORMING POPULATION
OF THE STUDY OF VALUES

t-Test	Low Strong		Norming Population		t	df	Significance
	Mean	SD	Mean	SD			
3.	42.54	8.81	42.78	7.92	0.20	2,541	NS ¹
	High Strong		Norming Population		t	df	Significance
	Mean	SD	Mean	SD			
4.	42.69	7.97	42.78	7.92	0.24	2,541	NS ¹

¹ Indicates the larger mean is not significantly greater than the smaller mean at the .05 level of probability.

TEST FOR HOMOGENEITY OF VARIANCE

t-Test	F	df (greater mean square listed first)	Significance
3.	1.24	53 and 2488	NS ²
4.	1.01	53 and 2488	NS ²

² Indicates the difference between the variances is not significant at the .02 level of probability.

TABLE XI

COMPARISON OF SCORES ON THE VARIABLE OF FAMILY RELATIONSHIPS OBTAINED
BY THE GROUPS SCORING LOW AND HIGH ON THE STRONG VOCATIONAL
INTEREST BLANK WITH THE NORMING POPULATION OF THE
MINNESOTA COUNSELING INVENTORY

t-Test	Low Strong		Norming Population		t	df	Significance
	Mean	SD	Mean	SD			
5.	10.80	5.78	9.6	6.8	1.2	252	NS ¹
	High Strong		Norming Population		t	df	Significance
	Mean	SD	Mean	SD			
6.	10.33	7.36	9.6	6.8	.69	252	NS ¹

¹ Indicates the larger mean is not significantly greater than the smaller mean at the .05 level of probability.

TEST FOR HOMOGENEITY OF VARIANCE

t-Test	F	df (greater mean square listed first)	Significance
5.	1.38	199 and 53	NS ²
6.	1.17	53 and 199	NS ²

² Indicates the difference between the variances is not significant at the .02 level of probability.

TABLE XII

COMPARISON OF SCORES ON THE VARIABLE OF THEORETICAL OR SYSTEMATIZATION OF KNOWLEDGE OBTAINED BY THE GROUPS SCORING LOW AND HIGH ON THE STRONG VOCATIONAL INTEREST BLANK WITH THE NORMING POPULATION OF THE STUDY OF VALUES

t-Test	Low Strong		Norming Population		t	df	Significance ¹
	Mean	SD	Mean	SD			
7.	41.19	6.60	43.75	7.34	2.81	2,541	$p < .005$
	High Strong		Norming Population				
	Mean	SD	Mean	SD			
8.	48.78	7.69	43.75	7.34	4.75	2,541	$p < .0005$

¹

Indicates the larger mean is greater than the smaller mean at the level of significance shown.

TEST FOR HOMOGENEITY OF VARIANCE

t-Test	F	df (greater mean square listed first)	Significance
7.	1.24	2488 and 53	NS ²
8.	1.10	53 and 2488	NS ²

²

Indicates the difference between the variances is not significant at the .02 level of probability.

population of the Study of Values (Table XII).

The group lacking the interests of scientists scored lower at the .05 level of significance on the Social Relationships scale of the Minnesota Counseling Inventory than the norming population (Table XIII). The group possessing the interests of scientists scored higher at the .01 level of significance on the Social Relationships scale than the norming population. Since a high score on the scale indicates poor social relationships, the group possessing the interests of scientists showed that they have significantly less adequate social relationships than the norming population of the test.

The group lacking the interests of scientists did not score significantly lower on the variable of Extraversion than the norming population of the Maudsley Personality Inventory (Table XIV). The group possessing the interests of scientists scored lower at the .01 level of significance on the variable of Extraversion than the norming population of the Maudsley Personality Inventory (Table XIV).

The group lacking the interests of scientists did not score significantly higher on the variable of Conformity than the norming population of the Minnesota Counseling Inventory (Table XV). The group possessing the interests of scientists scored lower at the .05 level of significance than the norming population (Table XV).

The group scoring low on the Strong obtained a score lower at the .0005 level of significance than the norming population of Kassarjian's Inner-Other-Directed Scale (Table XVI). The group scoring high on the Strong scored higher at the .0005 level of significance than the

TABLE XIII

COMPARISON OF SCORES ON THE VARIABLE OF SOCIAL RELATIONSHIPS OBTAINED
BY THE GROUPS SCORING LOW AND HIGH ON THE STRONG VOCATIONAL
INTEREST BLANK WITH THE NORMING POPULATION OF THE
MINNESOTA COUNSELING INVENTORY

t-Test	Low Strong		Norming Population		t	df	Significance ¹
	Mean	SD	Mean	SD			
9.	17.33	9.02	20.9	13.2	2.32	239	$p < .05$
	High Strong		Norming Population		t	df	Significance ¹
	Mean	SD	Mean	SD			
10.	25.35	12.10	20.9	13.2	2.24	252	$p < .01$

¹ Indicates the larger mean is greater than the smaller mean at the level of probability shown.

TEST FOR HOMOGENEITY OF VARIANCE

t-Test	F	df (greater mean square listed first)	Significance
9.	2.14	199 and 53	$p < .02$
10.	1.19	199 and 53	NS ²

² Indicates the difference between the variances is not significant at the .02 level of probability.

TABLE XIV

COMPARISON OF SCORES ON THE VARIABLE OF EXTRAVERSION OBTAINED BY THE GROUPS SCORING LOW AND HIGH ON THE STRONG VOCATIONAL INTEREST 'BLANK WITH THE NORMING POPULATION OF THE MAUDSLEY PERSONALITY INVENTORY

t-Test	Low Strong		Norming Population		t	df	Significance
	Mean	SD	Mean	SD			
11.	28.35	8.48	28.53	8.28	0.12	1,552	NS ¹
	High Strong		Norming Population		t	df	Significance
	Mean	SD	Mean	SD			
12.	25.04	10.34	28.53	8.28	2.46	144	$p < .01$ ²

¹ Indicates the larger mean is not significantly greater than the smaller mean at the .05 level of probability.

² Indicates the larger mean is greater than the smaller mean at the level of significance shown.

TEST FOR HOMOGENEITY OF VARIANCE

t-Test	F	df (greater mean square listed first)	Significance
11.	1.05	53 and 1,499	NS ³
12.	1.56	53 and 1,499	$p < .02$

³ Indicates the difference between the variances is not significant at the .02 level of probability.

TABLE XV

COMPARISON OF SCORES ON THE VARIABLE OF CONFORMITY OBTAINED BY THE GROUPS SCORING LOW AND HIGH ON THE STRONG VOCATIONAL INTEREST BLANK WITH THE NORMING POPULATION OF THE MINNESOTA COUNSELING INVENTORY

t-Test	Low Strong		Norming Population		t	df	Significance
	Mean	SD	Mean	SD			
13.	13.57	3.95	12.7	4.0	1.42	252	NS ¹
	High Strong		Norming Population		t	df	Significance
	Mean	SD	Mean	SD			
14.	11.50	3.90	12.7	4.0	2.0	252	$p < .05^2$

¹ Indicates the larger mean is not significantly greater than the smaller mean at the .05 level of probability.

² Indicates the larger mean is greater than the smaller mean at the level of significance shown.

TEST FOR HOMOGENEITY OF VARIANCE

t-Test	F	df (greater mean square listed first)	Significance
13.	1.03	199 and 53	NS ³
14.	1.05	199 and 53	NS ³

³ Indicates the differences between the variances is not significant at the .02 level of probability.

TABLE XVI

COMPARISON OF SCORES ON THE VARIABLE OF INNER-OTHER DIRECTEDNESS OBTAINED
BY THE GROUPS SCORING LOW AND HIGH ON THE STRONG VOCATIONAL INTEREST
BLANK WITH THE NORMING POPULATION OF KASSARJIAN'S
INNER-OTHER-DIRECTED SCALE

t-Test	Low Strong		Norming Population		t	df	Significance ¹
	Mean	SD	Mean	SD			
15.	61.37	9.79	72.20	16.93	5.64	204	$p < .0005$
	High Strong		Norming Population		t	df	Significance
	Mean	SD	Mean	SD			
16.	81.69	16.26	72.20	16.93	3.64	202	$p < .0005$

¹ Indicates the larger mean is greater than the smaller mean at the level of significance shown.

TEST FOR HOMOGENEITY OF VARIANCE

t-Test	F	df (greater mean square listed first)	Significance
15.	2.99	149 and 53	$p < .02$
16.	1.09	149 and 53	NS ²

² Indicates the difference between the variances is not significant at the .02 level of probability.

norming population of the Inner-Other-Directed test (Table XVI). Since a low score indicates other-directedness, the group scoring low on the Strong is more other-directed than the norming population, and the group scoring high on the Strong is more inner-directed than the norming population.

E. SUMMARY OF THE FINDINGS

Since the preceding findings concern details of the analysis, the results in relation to the hypotheses are now summarized.

Major Hypothesis I: Those choosing scientific careers who lack the interests of scientists do so due to the nature of their personality traits and because they perceive scientists to have social desirability.

Experimental Hypotheses:

1. Those choosing scientific careers who lack the interests of scientists will be more other-directed than those choosing scientific careers who have the interests of scientists.

This hypothesis was confirmed at the .005 level of probability.

2. Those choosing scientific careers who lack the interests of scientists will perceive science and scientists to have social desirability.

Of those desiring to become scientists, but lacking the interests of scientists, 92.4 per cent perceived science and scientists to have social desirability. Therefore this hypothesis was confirmed.

3. Those choosing scientific careers who lack the interests of scientists will score higher on conformity than those choosing scientific careers who have the interests of scientists.

Using the Conformity scale of the Minnesota Counseling Inventory it was found that those having the interests of scientists showed more conformity than those lacking the interests of scientists, with p being less than .005. The hypothesis was therefore not confirmed.

4. The social extraverts as described by Eysenck (1963) will correlate with the other-directed individuals.

The correlation between Other-Direction and Social Extraversion is .409. This hypothesis is therefore confirmed.

Major Hypothesis II: Those choosing scientific careers who have the interests of scientists will show more nearly the other personality traits generally ascribed to scientists than those lacking the interests of scientists.

Experimental Hypotheses:

1. Those choosing scientific careers who have the interests of scientists will show less neurotic tendency than those choosing scientific careers who lack the interests of scientists.

Although those lacking the interests of scientists scored higher on neuroticism than those possessing the interests of scientists, the difference is not significant. The hypothesis is therefore not substantiated.

2. Those choosing scientific careers who have the interests of scientists will be more introverted than those choosing scientific careers who lack the interests of scientists.

This hypothesis is confirmed at the .05 level of probability.

3. Those choosing scientific careers who have the interests of scientists will not be as well socially adjusted as those choosing scientific careers who lack the interests of scientists.

This hypothesis is substantiated at the .0005 level of probability.

4. Those choosing scientific careers who have the interests of scientists will not be as well adjusted to their family as those choosing scientific careers who lack the interests of scientists.

The students having the interests of scientists demonstrated healthier relationships with their families. The difference between the two groups is not statistically significant, however. This hypothesis is therefore not confirmed.

5. Those choosing scientific careers who have the interests of scientists will be less interested in economic considerations than those choosing scientific careers who lack the interests of scientists.

Those lacking the interests of scientists do show more interest in economic rewards. The difference, however, is not statistically significant. The hypothesis is therefore not confirmed.

6. Those choosing scientific careers who have the interests of scientists will be more interested in systematizing knowledge than those choosing scientific careers who lack interest in science.

This hypothesis is significant at the .0005 level of probability.

The squared multiple correlation coefficients show that the significant predictors in the presence of the other variables are the measures of Inner-Other Directedness and Systematization of Knowledge. Other-Directedness accounts for 17.5 per cent of the variance and the variable Systematization of Knowledge accounts for 5.0 per cent of the variance. The remaining factors account for 24.7 per cent of the variance. Listed in descending order of the proportion that each contributes to the explained variance these factors are: Social Relationships, Conformity, Family Relationships, Neuroticism, Extraversion, and Economic Concerns.

The variables of Neuroticism, Economic Concerns, and Family Relationships did not differentiate either the group possessing the interests of scientists or the group lacking the interests of scientists from the norming populations of the psychological tests measuring these variables. The variables of Extraversion and Conformity did not differentiate the group lacking the interests of scientists from the norming populations of the tests measuring the variables.

The group lacking the interests of scientists scored significantly lower than the norming populations on the following variables: Systematization of Knowledge, Social Relationships, and Inner-Other Directedness.

The group possessing the interests of scientists scored significantly higher than the norming populations of the psychological tests on the following variables: Systematization of Knowledge, Social Relationships, and Inner-Other Directedness; and scored lower than the norming populations on the following variables: Extraversion, and Conformity.

CHAPTER VII

CONCLUSIONS, IMPLICATIONS FOR FURTHER RESEARCH, IMPLICATIONS FOR EDUCATIONAL PRACTICE

Chapter VII presents explanations as to why individuals desire to become scientists. Explanations are presented in the theoretical framework of the cultural-psychodynamic approach to vocational choice. This approach sees the choice of a career as based upon the interaction of cultural and personality variables.

In the literature describing the attributes of scientists and science students there is no general consensus as to the traits possessed by the aforementioned groups on the variables of social relations and conformity. There has been more or less general agreement as to the characteristics science students and scientists possessed in the areas of family relationships, emotional stability, interest in intellectual pursuits, and interest in economic rewards. For the most part, the literature describing the characteristics of science students and scientists is prior to 1957. A new factor in North American culture, namely, the greatly increased prestige of science and scientists, is now operative. The effect that this new cultural variable has on certain personality types in the choosing of a scientific career has been investigated.

Two groups desiring to become physical scientists were studied:

- (1) a group of students possessing the interests of physical scientists
- and (2) a group of students lacking the interests of physical scientists

but who considered a scientific career socially desirable. Those traits which both groups have in common and those which differentiate the two groups will first be discussed. Following will be an investigation of the relation of Other-Directedness to the various dimensions of Extraversion. Then, the limitations of the study will be examined. Finally, the implications of this investigation for further research and educational practice will be discussed.

A. CHARACTERISTICS SHARED BY THE GROUPS POSSESSING AND
LACKING THE INTERESTS OF SCIENTISTS

Three of the variables examined did not differentiate the group possessing the interests of scientists from the group lacking the interests of scientists. These factors were the following: Neuroticism, as measured by the Maudsley Personality Inventory; Economic Concerns, as measured by the Study of Values; and Family Relationships, as measured by the Minnesota Counseling Inventory.

Studies (Drevdahl, 1954; Eiduson, 1962; Knapp, 1963; Roe, 1952; Teevan, 1954; Terman, 1954) have reported that science students were more emotionally stable than those following other careers. The investigators found that science students and scientists compared to the general population had less neurotic tendencies such as anxieties and fears. Therefore, it was concluded that the classification of neurotic would not be applicable to science students and scientists. This investigation found that those possessing the interests of scientists compared to those lacking the interests did not receive a significantly lower score on the

Neuroticism variable. Moreover, the group possessing the interests of scientists did not score significantly lower on Neuroticism than the normal population on which the Maudsley Personality Inventory was normed. There was no significant difference between the group scoring low on the interests of scientists and the norming population of the Maudsley Personality Inventory. The factor of Neuroticism can therefore not contribute to an explanation of why individuals are choosing scientific careers today.

The second variable that did not differentiate the groups of students aspiring to become scientists was the variable of Economic Concerns. Various investigators (Eiduson, 1962; Roe, 1952; Stone, 1957) have reported that scientists and science students had less concern about economic rewards than individuals of other occupational groups. This investigation does not support this finding. The group possessing the interests of scientists did not score significantly lower on the variable of Economic Concerns than the group lacking the interests of scientists. The multivariate analyses, indeed, showed that the factor of Economic Concerns contributed the least of all the variables to the variance accounted for. Moreover, the group possessing the interests of scientists did not score significantly lower on Economic Concerns than the college population on which the Study of Values was normed. It can therefore be concluded that the variable of Economic Concerns as measured by the Study of Values does not aid in explaining the choice of a scientific career.

The final factor on which no significant difference was found between the two groups of students choosing scientific careers was

the variable of Family Relationships. It has been reported that atypical family relationships existed between science students and their families with maladjustments in parent-child relations much in evidence (Eiduson, 1962; Stone, 1957). This investigation found no significant difference between the two groups of students wishing to become scientists on the variable of Family Relationships as measured by the Minnesota Counseling Inventory. The variable of Family Relations cannot, therefore suggest a reason for individuals selecting scientific careers.

B. VARIABLES DIFFERENTIATING THE GROUPS POSSESSING AND LACKING
THE INTERESTS OF SCIENTISTS

The variables that differentiate the group possessing the interests of scientists, and the group lacking the interests of scientists, are now discussed. It is among these variables that explanations of why individuals choose scientific careers may be found. The group possessing the interests of scientists compared to the group lacking the interests of scientists scored significantly higher on the variables of Inner-Directedness, Systematization of Knowledge, Conformity, and Introversion; and scored significantly lower on the variable of Adequacy of Social Relations.

Various investigators (Bello, 1954; Brandwein, 1955; MacCurdy, 1956; Roe, 1952; Stone, 1957) have described scientists and science students as having showed great interest in intellectual pursuits, with curiosity playing a major role in their motivation. They have been described as critical and rational men whose work was central to their

lives. This investigation found that the variable Systematization of Knowledge of the Study of Values was a very significant factor in distinguishing the group possessing the interests of scientists from the group lacking the interests of scientists. The group possessing the interests of scientists scored higher on Systematization of Knowledge at the .0005 level of significance. The group possessing the interests of scientists also scored higher on the variable of Systematization of Knowledge at the .005 level of significance than the norming population of the Study of Values. In the multivariate analyses it was one of the two variables that was a significant predictor in the presence of the other factors. It also accounted for 5 per cent of the variance. The group lacking the interests of scientists, not only scored significantly lower than the group possessing the interests of scientists, but also scored significantly lower on this variable than the norming population of the Study of Values. It can be concluded that the variable Systematization of Knowledge is an important factor in motivating the group possessing the interests of scientists to select scientific careers; but does not suggest a reason why the group lacking the interests of scientists should wish to follow a career in science.

Previous studies are in disagreement as to the social relationships that scientists and science students enjoyed. Some investigators (Eiduson, 1962; Roe, 1953b; Shannon, 1947; Stone, 1957; Terman, 1954) found that science students had little social interaction with others, not deeply involving themselves emotionally in dealing with and considering human relations. These studies showed that science students

were slow in psychosocial development, showing less interest in interpersonal relations than individuals in other occupations. The scientists and science students also showed a tendency toward Introversion.

Other investigators (Brandwein, 1955; Strauss, 1957) found that science students were socially minded, enjoyed social contacts, and recognized the importance of other people. They did not shy away from strong interpersonal relations. They had become leaders in organizations that consisted of their peers and enjoyed being leaders.

It was found that the group possessing the interests of scientists showed themselves to have significantly less adequate social relationships than the group lacking the interests of scientists and significantly less adequate social relationships than the norming population of the Minnesota Counseling Inventory. These findings, perhaps, are not too surprising when the stereotype of the scientist is considered. What is perhaps unexpected is that the group lacking the interests of scientists not only showed themselves to be more gregarious and to have more adequate social skills than the groups possessing the interests of scientists, but in these respects also surpassed the norming population of the Minnesota Counseling Inventory. The group lacking the interests of scientists showed greater interests, significant beyond the .01 level of probability, in social relationships than the norming population of the Minnesota Counseling Inventory. The findings regarding social relationships without further elaboration do not help to explain why the group lacking the interests of scientists are choosing scientific careers. In conjunction with a variable yet to be discussed, however, the

finding that the group lacking the interests of scientists showed themselves to have significantly more adequate social relationships is not surprising. In the multivariate analyses, the variable Social Relationships ranked third among the variables in accounting for the explained variance.

Although consensus as to whether or not science students and scientists, as a group, are introverted or extroverted is lacking, the majority of the investigations (Eiduson, 1962; MacCurdy, 1956; Roe, 1953b; Stone, 1957; Terman, 1954) have found scientists and science students to be introverted. This investigation found that the group scoring higher on the science scales of the Strong scored significantly lower on Extraversion than the group scoring lower on the science scales of the Strong. The group possessing the interests of scientists also scored significantly lower on the variable of Extraversion than the norming population of the Maudsley Personality Inventory. The group lacking the interests of physical scientists were neither significantly lower nor higher on the variable of Extraversion than the norming population of the Maudsley Personality Inventory. The difference, then, on the variable of Extraversion between the two groups of students aspiring to become physical scientists is likely due to the group possessing the interests of scientists being more introverted than the general population. This finding suggests that Introversion is a significant variable in the personality of the one group of students wishing to become scientists. This variable, however, does not suggest a reason as to why the students lacking the interests of scientists should

wish to choose a scientific career.

Of those variables differentiating the groups possessing and lacking the interests of scientists, the variable of Extraversion in the multivariate analyses contributes least to the explanation of the variance accounted for. Investigators (Bello, 1954; Cattell and Drevdahl, 1955; Cooley, 1963; Stone, 1957) have found a degree of nonconformity and independence among science students, but these characteristics have been accompanied by more reliable and responsible behavior than that found in those who chose other careers. Generally, those planning to become scientists showed a stronger sense of control and self-discipline. This investigation found that the group possessing the interests of scientists scored significantly lower on the Conformity scale of the Minnesota Counseling Inventory than the group of students lacking the interests of scientists. A low score on the scale describes individuals who are reliable and responsible, conforming to behavior codes even when they may not agree with them. Such individuals ordinarily show respect to persons in authority, although they are not necessarily docile nor overly submissive. The group possessing the interests of scientists also scored lower on the Conformity scale than the norming population of the Minnesota Counseling Inventory. There was no significant difference between the scores of the group lacking the interests of scientists and the norming population. It can therefore be concluded that the lower score on Conformity is unique to the group desiring to become scientists and possessing the interests of scientists.

At this point in the discussion, in attempting to explain why

individuals today are choosing scientific careers, reasons can only be offered for the group possessing the interests of scientists. In the first instance, obviously, this group does have the interests of scientists. In addition to having the interests of scientists as measured by the Strong Vocational Blank, this group also possessed certain other personality attributes that scientists and science students have been described as possessing. Compared to the group lacking the interests of scientists the group possessing the interests of scientists scored more like scientists at a statistically significant level on the following variables: Systematization of Knowledge, Extraversion, Social Relationships, and Conformity.

From the characteristics observed thus far, reasons are lacking as to why the second group of students should desire to become physical scientists. Not only do they lack the interests of physical scientists, but they also scored lower than the group possessing the interests of scientists on the variables of Systematization of Knowledge, Extraversion, Social Relationships, and Conformity. Two variables which are yet to be examined appear to suggest a reason as to why the group lacking the interests of scientists aspire to become physical scientists.

It was found that the group lacking the interests of scientists scored higher at the .0005 level of significance on Other-Directedness than the group possessing the interests of scientists, and also scored more Other-Directed at the .005 level of significance than the norming population of the Inner-Other-Directed Scale. In the multivariate analyses the squared multiple correlation coefficients showed the variable

of Inner-Other Directedness to be a significant predictor in the presence of the other variables beyond the .001 level of significance. By accounting for 17.5 per cent of the variance it accounted for more of the explained variance than any of the other variables.

According to Riesman (1961) the source of direction for other-directed individuals is their contemporaries, either those known to the individual, or those with whom he is indirectly acquainted, such as through friends or the mass media. Such individuals have an exceptional sensitivity to the wishes of others. Having the approval of others is the chief source of direction for other-directed people. The goals which other-directed individuals seek is determined by their contemporaries.

Of the students who wished to become physical scientists, but who lacked the interests of scientists, 92.4 per cent perceived a career in science as being socially desirable. Therefore an explanation for individuals desiring to be trained for a scientific career when they lack the interests and other personality attributes of scientists can be explained by their other-directed personalities, which make them susceptible to the influence of their contemporaries, and their perception of a career in science as being socially desirable.

This conclusion is supported by the score the group lacking the interests of scientists made on the Social Relationships scale of the Minnesota Counseling Inventory. The group lacking the interests of scientists not only scored lower at the .0005 level of significance than the group possessing the interests of scientists, but also scored

lower at the .05 level of significance on the Social Relationships scale than the norming population of the Minnesota Counseling Inventory. In the multivariate analyses it ranked third, only behind the variables of Inner-Other Directedness and Systematizing Knowledge, in accounting for the explained variance. A low score on the Social Relationships scale characterizes individuals who are gregarious and socially mature. These individuals are well-liked by others. In general, they have good social skills and conduct themselves appropriately in social situations. According to Riesman (1961) the other-directed individual "wants to be loved" and "to relate" to others. He seeks to be "emotionally in tune" with other people. It follows that other-directed individuals would get along well with others because, according to Riesman (1961) being liked by other people is of paramount significance to them.

It is interesting to observe that monetary considerations do not appear to be a prime motivating factor in the choice of a scientific career for either the group possessing the interests of scientists or the group lacking the interests of scientists. Neither the group possessing the interests of scientists nor the group lacking the interests of scientists scored significantly higher on the variable of Economic Concerns than the norming population of the Study of Values. Nor did the group lacking the interests score higher on the variable of Economic Concerns than the group possessing the interests of scientists. It is therefore concluded that the important factor motivating the individuals who lack the interests of scientists to choose scientific careers is their other-directed characters and the prestige that they perceive science and scientists to enjoy,

rather than thought of monetary concerns. It also follows that monetary considerations are not an important factor contributing to the prestige that these individuals perceive science to have. This conclusion, moreover, is consonant with Riesman's description of the other-directed individual:

The other-directed person wants to be loved rather than esteemed; he wants not to gull or impress, let alone oppress others, but, in the current phrase, to relate to them; he seeks less a snobbish status in the eyes of others than assurance of being emotionally in tune with them (Riesman, 1961, p. xx).

C. THE RELATION OF OTHER-DIRECTEDNESS TO EXTRAVERSION

In order to investigate which of the other factors examined might explain a personality type subject to social considerations, the other variables were examined both theoretically and experimentally from this point of view. Eysenck (1963) has defined the Extravert as a personality type characterized by the behavioral correlates of sociability, a love of people, and social activity. The typical extravert, according to Eysenck's (1959) definition, needs people to talk to. The Sociable Extravert, as defined by Eysenck (1963) is the individual with the personality type conforming to the concept of Extraversion which stresses strong social affinities and ease in interpersonal relationships. The Impulsive Extravert, as defined by Eysenck (1963), is the personality type conforming to a relative lack of super ego controls and has a tendency to act on the spur of the moment. Riesman (1961) has stated that the other-directed individual is greatly concerned about relating well to others. By comparing the writings of Riesman (1961) and

and Eysenck (1963) it might be concluded that there is a positive relationship between the variable of Social Extraversion and the variable of Other-Directedness. The coefficient of correlation of .409 between Sociable Extraversion and Other-Directedness shows that this is the case. Of the variables dealt with in the present investigation, the variable of Other-Directedness correlated highest with the variable of Social Extraversion. Therefore it is concluded that the variable of Other-Directedness is not a pure measure, but has a factor in common with Social Extraversion.

D. LIMITATIONS OF THE STUDY

The foregoing conclusions are subject to the following limitations. The conclusions are valid only insofar as the sample is representative of grade 12 students desiring to become physical scientists. Secondly, the conclusions are applicable only within the framework of the terms as defined. Finally, those desiring to enter the physical sciences were dealt with as one group. A deeper understanding of the reasons motivating individuals to enter careers in the physical sciences might have resulted by examining each particular occupational group in the physical sciences separately and students choosing other careers.

E. IMPLICATIONS FOR FURTHER RESEARCH

Studies examining the same group of students during various stages of their careers would be useful in determining which tests and which combination of tests are the most useful predictors in forecasting

successful completion of training for a career in science. Further follow-up studies could determine which test or combination of tests predict individuals who, after having completed training for a scientific career later leave the profession; and such follow-up studies could determine which factors predict success and happiness of individuals who, are following scientific careers.

It would be of value to examine adults who, today, are practising scientists in order to ascertain if there are any in the field who lack the measured interests of scientists. If there are such individuals, to what extent are they other-directed, and are they successful and happy in their profession.

Examining variables in the same theoretical framework used in the present study that cause individuals to choose other careers would provide further insight into factors motivating individuals to choose careers today. Both students and practitioners in the field could profitably be examined.

There is a further area that could be investigated. Would providing the students with accurate information regarding the nature of scientific work and informing those who lack the interests of scientists that the odds that they will enter a scientific career are not in their favor cause them to reconsider their occupational choice? In other words, would information of a cognitive nature be a more powerful determinant of behavior in this case than personality factors?

F. IMPLICATIONS FOR EDUCATIONAL PRACTICE

The youth of today has little opportunity to observe men at work. This is particularly true in the case of technical and scientific work. The schools, therefore, have been required to provide information for students about themselves in relation to possible careers, and to provide the students with information regarding careers. Information that can enlighten students about themselves in relation to their choice of careers may aid the student in making a more adequate choice of a career.

From this study it is evident that there is a group of students desiring to become physical scientists, but having personality attributes of a nature which would appear to make it unlikely that they will achieve their occupational goal. They desire to become physical scientists because, at least in part, they have the personality attributes that make them susceptible to yielding to social considerations.

If the teachers and guidance personnel could present to the student the nature of scientific work as it actually is, perhaps those lacking the interests of scientists, but wishing to become scientists because of social considerations would make a more realistic occupational decision. The science teachers could place the students in contact with science and scientists. Rather than just telling the students the results of scientific investigation, the science teacher might allow students to actually engage in scientific inquiry, that is, to develop and test hypotheses; in other words, to educate the students as to the nature of the scientific endeavor.

This study has shown that in regard to the problem of informing students about themselves in relation to science and scientists, certain tests provide more unique information than others. Students now spend considerable amounts of time taking tests, with according to Cooley (1963) too little "payoff;" that is, certain tests add very little more information regarding an individual than other tests he has already taken. This investigation found that with regard to tests indicating personality factors separating students possessing the interests of scientists from students lacking the interests of scientists, two of the eight variables investigated accounted for over half of the explained variance. The factors were the variables of Inner-Other Directedness and Systematization of Knowledge.

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A P P E N D I C E S

APPENDIX A

EXPERIMENTAL DATA

KEY TO COLUMN HEADINGS
FOR RAW DATA

COLUMN #

1. Subject Number
2. Age
3. School
 - B - Bonnie Doon Composite High School
 - E - Eastglen Composite High School
 - P - Jasper Place Composite High School
 - O - O'Leary High School
 - X - St. Francis Xavier High School
 - J - St. Joseph's High School
 - M - St. Mary's High School
 - Q - Queen Elizabeth Composite High School
4. Strong - Mathematician
5. Strong - Physicist
6. Strong - Engineer
7. Strong - Chemist
8. Inner-Other Directedness
9. Family Relationships
10. Social Relationships
11. Conformity
12. Neuroticism
13. Extraversion

14. Systematizing Knowledge or Theoretical
15. Economic
16. Impulsive Extraversion
17. Sociable Extraversion

SCORES OBTAINED ON THE TESTS BY THE GROUP
SCORING LOW ON THE STRONG

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	17-8	E	20	14	21	25	41	16	24	9	15	28	36	49	21	26
2	17-7	E	23	21	23	35	71	5	28	8	30	33	52	31	15	28
3	21-5	X	15	16	30	33	60	11	5	14	7	39	57	36	16	33
4	17-3	Q	28	22	26	27	73	7	9	16	17	26	38	39	24	30
5	20-1	X	21	16	30	34	65	9	16	14	13	29	40	36	22	34
6	17-0	P	18	17	24	34	51	3	14	16	10	14	43	49	26	32
7	17-9	J	15	16	29	34	62	3	12	13	20	32	43	44	22	25
8	17-7	Q	24	16	20	27	43	20	38	17	30	22	39	30	20	8
9	18-5	E	17	09	18	27	53	5	15	14	12	13	42	41	25	33
10	18-0	Q	14	18	28	32	71	7	10	10	20	41	48	42	32	35
11	17-0	E	17	15	23	27	45	3	8	12	18	33	41	49	19	33
12	18-4	J	07	-06	10	.09	52	14	22	11	33	27	33	36	30	27
13	17-7	J	04	-08	15	05	59	9	1	12	6	44	42	35	22	35
14	18-0	J	04	-06	08	03	42	7	17	15	35	33	28	50	19	27
15	17-9	B	01	-09	09	12	63	19	20	13	24	24	44	50	18	22
16	16-11	B	18	13	26	28	61	11	13	10	20	27	40	30	15	24
17	19-0	B	06	10	32	24	57	19	12	18	24	40	56	71	23	36
18	17-10	B	17	16	30	32	55	6	6	11	8	46	45	47	30	40
19	17-5	B	24	14	28	26	70	10	35	12	26	25	49	46	17	19
20	17-5	P	11	13	27	27	72	12	19	16	21	20	42	37	22	28
21	17-1	P	29	16	18	32	62	19	14	17	19	38	43	52	20	32
22	17-11	O	18	13	30	29	65	8	14	12	28	26	41	46	21	22
23	16-11	J	11	07	18	18	59	17	14	15	26	38	43	48	20	26
24	18-7	J	11	07	28	13	53	12	12	14	25	23	47	49	9	31
25	17-4	P	16	10	28	29	75	5	35	9	32	30	48	45	16	20
26	17-4	J	27	13	16	20	59	14	25	12	19	11	38	28	9	16
27	19-3	J	17	07	13	19	66	15	13	16	26	38	41	35	21	24

cont'd.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
28	16-11	J	12	05	10	19	48	10	34	8	42	19	37	37	16	18
29	20- 8	J	08	02	16	15	62	20	8	21	28	24	40	42	21	27
30	18--5	M	32	23	16	25	60	10	16	10	34	25	47	21	13	25
31	17- 6	J	24	10	15	21	75	13	11	19	36	39	33	47	21	33
32	18- 1	J	31	18	13	20	73	13	15	9	25	26	40	26	14	22
33	17- 7	J	07	07	31	20	56	15	19	14	36	36	38	41	28	30
34	17- 8	J	19	08	13	18	61	8	34	12	34	12	36	38	9	16
35	17- 7	M	10	-05	11	03	77	5	16	9	19	23	38	53	9	30
36	18- 5	J	17	13	30	28	76	2	9	12	14	33	45	44	14	31
37	17- 3	0	22	21	22	23	58	11	8	10	5	33	44	38	19	33
38	18- 8	0	04	04	28	27	53	10	7	15	19	32	50	35	23	25
39	17- 4	B	05	02	20	10	48	5	31	8	24	18	36	59	23	36
40	16-11	0	15	17	31	33	57	7	19	19	19	23	36	48	17	30
41	17- 2	0	16	10	30	21	74	7	7	15	17	22	39	44	21	34
42	18- 9	0	16	10	21	17	59	6	24	13	14	25	26	52	22	16
43	19-10	M	21	21	19	29	64	17	14	16	22	28	45	43	8	27
44	18- 6	M	22	17	32	26	71	6	11	16	23	32	34	37	12	37
45	18- 2	M	11	02	17	11	70	15	28	13	15	21	58	37	20	21
46	17- 6	M	15	13	28	22	72	18	23	20	15	36	41	39	13	29
47	16- 0	M	19	16	29	33	51	4	27	11	28	14	37	50	20	24
48	16-11	M	22	02	09	10	82	12	17	9	16	27	32	46	19	21
49	16- 6	M	20	13	30	27	51	31	18	30	41	38	45	52	20	24
50	16- 6	M	25	18	25	29	57	8	24	12	16	27	34	36	22	22
51	17- 0	J	05	01	25	11	61	2	15	11	10	20	36	53	18	26
52	17- 5	M	08	-04	12	13	61	16	10	18	16	38	32	31	18	30
53	17- 2	M	19	16	28	32	57	16	5	16	22	40	48	47	16	32
54	17- 6	0	19	12	30	27	76	10	35	11	20	20	38	50	12	12

SCORES OBTAINED ON THE TESTS BY THE GROUP
SCORING HIGH ON THE STRONG

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
55	16-4	P	44	46	57	52	100	9	44	9	27	11	54	48	9	9
56	18-0	X	38	37	43	46	87	6	28	9	4	21	56	41	11	17
57	16-11	X	37	39	44	51	85	12	22	17	25	33	59	46	28	35
58	17-7	X	31	38	46	50	95	7	11	13	23	33	41	34	23	25
59	18-2	X	44	43	52	52	94	14	6	17	15	34	35	54	16	28
60	17-3	X	40	44	43	55	82	11	38	9	30	7	49	43	11	9
61	17-6	X	37	41	43	53	67	14	11	10	19	33	60	22	9	33
62	16-5	E	38	43	42	53	105	18	15	18	28	15	62	29	3	10
63	17-2	E	31	40	45	50	79	20	22	11	36	38	44	41	16	22
64	17-9	Q	35	45	55	52	110	6	36	10	26	7	58	42	6	7
65	17-10	Q	30	32	48	51	79	2	14	10	11	36	57	42	9	32
66	17-11	Q	37	42	51	58	96	13	35	7	14	16	37	52	16	10
67	17-7	Q	35	35	44	57	92	8	22	13	34	26	56	36	18	24
68	16-11	Q	40	41	50	50	90	2	21	7	8	21	41	38	15	16
69	17-11	E	37	40	47	46	100	14	36	7	20	10	60	32	6	8
70	17-11	E	43	45	43	51	80	11	30	17	11	22	41	42	11	23
71	16-6	Q	40	37	48	41	77	3	6	7	8	42	40	47	15	34
72	17-11	Q	33	39	53	51	71	5	21	5	27	26	57	37	10	30
73	17-8	Q	31	36	53	46	50	22	18	16	18	26	49	49	21	25
74	17-3	Q	32	34	50	41	77	2	7	9	12	36	28	48	19	38
75	17-2	J	40	51	62	58	83	1	47	12	26	15	53	54	5	4
76	18-5	J	37	47	47	51	56	28	18	17	25	29	47	35	21	23
77	18-1	J	41	41	46	38	78	4	38	3	31	16	54	39	15	15
78	17-10	B	37	38	43	46	106	19	49	8	40	4	39	43	12	4
79	17-0	B	40	44	52	46	75	0	30	9	4	34	52	50	14	26
80	18-3	B	25	32	55	47	89	46	36	17	29	14	50	57	13	18
81	18-5	B	46	47	55	48	120	2	35	10	11	14	36	32	10	11

cont'd.

I	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
82	18-5	B	32	36	48	46	78	12	16	13	7	31	42	36	26	27
83	17-9	B	47	43	41	51	71	8	28	19	46	36	54	32	24	24
84	17-1	B	43	42	53	45	76	5	26	12	32	25	49	51	13	21
85	18-8	B	30	44	60	52	92	12	38	13	23	26	46	38	20	13
86	17-6	X	31	44	51	50	62	27	33	17	41	34	54	46	24	28
87	17-7	B	37	41	48	47	74	24	47	17	39	21	43	44	26	13
88	17-0	B	41	39	39	45	55	9	21	11	24	26	56	43	14	22
89	17-3	B	43	44	51	51	62	9	14	11	14	40	58	47	9	15
90	18-2	P	31	34	52	47	76	2	7	14	29	33	44	46	16	36
91	17-10	B	43	41	39	47	74	5	17	10	17	30	50	44	8	34
92	17-5	B	37	41	49	56	79	1	22	7	6	46	61	56	26	32
93	17-10	P	34	38	46	53	80	8	3	11	11	7	49	50	25	16
94	17-9	P	41	38	50	46	70	14	33	9	26	12	54	58	10	11
95	17-2	P	44	36	39	46	50	21	14	19	24	21	51	32	9	33
96	17-11	P	39	36	44	41	83	13	19	13	14	28	52	41	12	27
97	16-9	P	38	31	41	50	88	17	50	11	24	34	49	40	22	2
98	18-4	P	34	44	61	50	63	8	17	15	24	24	47	45	20	22
99	16-11	X	37	44	56	51	76	4	31	11	20	21	47	34	21	8
100	17-0	M	44	49	53	53	77	15	30	7	9	24	42	54	13	16
101	16-4	M	35	41	52	51	84	2	40	8	22	18	44	53	22	12
102	16-11	M	39	38	42	52	102	4	26	8	32	26	50	28	10	17
103	16-11	M	41	42	53	53	85	2	42	6	4	8	49	46	16	4
104	17-5	L	41	47	53	51	133	11	14	14	18	30	53	42	26	24
105	17-5	L	31	34	47	52	77	17	26	15	8	40	46	42	16	24
106	17-10	L	36	38	49	53	64	6	21	6	12	19	31	31	14	12
107	18-6	L	30	40	63	54	65	19	29	15	26	38	53	49	27	25
108	17-10	X	37	34	48	42	92	4	9	10	31	35	45	44	18	28

APPENDIX B. TESTS USED

KASSARJIAN'S INNER-OTHER-DIRECTED SCALE

Direction: A number of controversial statements or questions with two alternative answers are given below. Answer every item as it applies to you. Indicate your preference by writing appropriate figures in the boxes to the right of each question. Some of the alternatives may appear equally attractive or unattractive to you. Nevertheless, please make a real attempt to choose the alternative that is relatively more acceptable to you.

If you definitely agree with alternative (a) and disagree with (b), write 2 in the first box and leave the second blank: (2)

If you definitely agree with (b) and disagree with (a), write 2 in the second box leaving the first blank:

If you have a slight preference for (a) over (b), write: (1) ()
a ()

If you have a slight preference for (b) over (a), write: () (1)
b ()

If you have a slight preference for (b) over (a), write: () (1)

Do not write any combination of numbers except one of the four given. Never write more than one figure in for any one question. There are no right or wrong answers to this questionnaire. Do not spend too much time on any one item. And please do not leave out any of the questions unless you find it really impossible to make a decision.

1. With regard to partying, I feel

- a. the more the merrier (25 or more people present); a
b. it is nicest to be in a small group of intimate b
 friends (6 or 8 people at most). ()

2. If I had more time

- a. I would spend more evenings at home doing the things a b
I'd like to do; () ()
- b. I would more often go out with my friends.

3. If I were trained as an electrical engineer and liked my work very much and would be offered a promotion into an administrative position, I would

- a. accept it because it means an advancement in pay which I need quite badly;
- b. turn it down because it would no longer give me an opportunity to do the work I like and am trained for even though I desperately need more money.

4. I believe that

- | | a | b |
|----|--|-----|
| a. | it is difficult to draw a line between work and play and therefore one should not even try it; | () |
| b. | one is better off keeping work and social activities separated. | () |

5. I would rather join

- | | | |
|---|-----|-----|
| | a | b |
| a. a political or social club or organization; | () | () |
| b. an organization dedicated to literary, scientific
or other academic subject matter. | | |

6. I would be more eager to accept a person as a group leader who

- a. is outstanding in those activities which are important to the group;
- b. is about average in the performance of the group activities but has an especially pleasing personality.

7. I like to read books about

- a. people like you and me;
b. great people or adventurers.

8. For physical exercise or as a sport I would prefer

- a. softball, basketball, volleyball, or similar team sport;
- b. skiing, hiking, horsebackriding, bicycling, or similar individual sport.

9. With regard to job, I would enjoy more
a. one in which one can show his skill or knowledge; a b
b. one in which one gets in contact with many different people. () ()
10. I believe
a. being able to make friends is a great accomplishment in and of itself; a b
b. one should be concerned more about one's achievements rather than with making friends. () ()
11. It is more desirable
a. to be popular and well-liked by everybody; a b
b. to become famous in the field of one's choice or for a particular deed. () ()
12. With regard to clothing
a. I would feel conspicuous if I were not dressed the way most of my friends are dressed; a b
b. I like to wear clothes which stress my individuality and which not everybody else is wearing. () ()
13. On the subject of social living
a. a person should set up her own standards and then live up to them; a b
b. one should be careful to live up to the prevailing standards of the culture. () ()
14. I would consider it more embarrassing
a. to be caught loafing on a job for which I get paid; a b
b. losing my temper when a number of people are around of whom I think a lot. () ()
15. I respect the person most who
a. is considerate of others and concerned that they think well of him; a b
b. lives up to his ideals and principles. () ()
16. A child who has had intellectual difficulties in some grade in school
a. should repeat the grade to be able to get more out of the next higher grade; a b
b. should be kept with his age group though he has some intellectual difficulties. () ()
17. In my free time
a. I'd like to read an interesting book at home; a b
b. I'd rather be with a group of my friends. () ()
18. I have
a. a great many friends who are, however, not very intimate friends; a b
b. few but rather intimate friends. () ()
19. When doing something, I am most concerned with
a. "what's in it for me" and how long it will last; a b
b. what impression others get of me for doing it. () ()
20. As leisure-time activity I would rather choose
a. woodcarving, painting, stamp collecting, photography, a similar activity; a b
b. bridge or other card game, or discussion groups. () ()
21. I consider a person most successful when
a. he can live up to his own standards and ideals; a b
b. he can get along with even the most difficult people. () ()

22. One of the main things a child should be taught is
 a. cooperation; a b
 b. self-discipline. () ()
23. As far as I am concerned
 a. I am only happy when I have people around me; a b
 b. I am perfectly happy when I am left alone. () ()
24. On a free evening
 a. I like to go and see a nice movie; b
 b. I would try to have a television party at my (or a friend's) house. () ()
25. The persons whom I admire most are those who
 a. are very outstanding in their achievements; a b
 b. have a very pleasant personality. () ()
26. I consider myself to be
 a. quite idealistic and to some extent a "dreamer"; a b
 b. quite realistic and living for the present only. () ()
27. In bringing up children, the parents should
 a. look more at what is done by other families with children; a b
 b. stick to their own ideas on how they want their children brought up regardless of what others do. () ()
28. To me it is very important
 a. what one is and does regardless of what others think; a b
 b. what my friends think of me. () ()
29. I prefer listening to a person who
 a. knows his subject matter real well but is not very skilled in presenting it interestingly; a b
 b. knows his subject matter not as well but has an interesting way of discussing it. () ()
30. As far as I am concerned
 a. I see real advantages to keeping a diary and would like to keep one myself; a b
 b. I'd rather discuss my experiences with friends than keep a diary. () ()
31. Schools should
 a. teach children to take their place in society; a b
 b. be concerned more with teaching subject matter. () ()
32. It is desirable
 a. that one shares the opinions others hold on a particular matter; a b
 b. that one strongly holds onto his opinions even though they may be radically different from those of others. () ()
33. For me it is more important to
 a. keep my dignity (not make a fool of myself) even though I may not always be considered a good sport; a b
 b. be a good sport even though I would lose my dignity (make a fool of myself) by doing it. () ()
34. When in a strange city or foreign country I should have no great difficulty because
 a. I am interested in new things and can live under almost any conditions; a b
 b. people are the same everywhere and I can get along with them. () ()

keep a diary.

P. I, a teacher, presents my experience

time in school and my work

Q. I am not a teacher, but I am

30. As far as I am concerned

presenting my

P. I am not a teacher, but I am

Q. I am not a teacher, but I am

30. As far as I am concerned

30. As far as I am concerned

Q. I am not a teacher, but I am

30. As far as I am concerned

30. As far as I am concerned

Q. I am not a teacher, but I am

30. As far as I am concerned

Q. I am not a teacher, but I am

30. As far as I am concerned

Q. I am not a teacher, but I am

30. As far as I am concerned

30. As far as I am concerned

Q. I am not a teacher, but I am

30. As far as I am concerned

30. As far as I am concerned

Q. I am not a teacher, but I am

30. As far as I am concerned

30. As far as I am concerned

35. I believe in coffee breaks and social activities for employees because

- a. it gives people a chance to get to know each other and enjoy work more;
- b. people work more efficiently when they do not work for too long a stretch at a time and can look forward to special events.

a
()

b
()

36. The greatest influence upon children should be

- a. from their own age group and from educational sources outside the family since they can be more objective in evaluating the child's needs;
- b. from the immediate family who should know the child best.

a
()

b
()

10

[illegible]

SOCIABILITY-IMPULSIVENESS SCALE

Instructions:

Read each statement carefully and decide whether you agree or disagree with it. Mark your response in the space provided.

1. I often feel nervous when I am in a group of people. ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

2. I often feel nervous when I am in a group of people. ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

3. I often feel nervous when I am in a group of people. ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

4. I often feel nervous when I am in a group of people. ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

5. I often feel nervous when I am in a group of people. ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

6. I often feel nervous when I am in a group of people. ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

7. I often feel nervous when I am in a group of people. ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

8. I often feel nervous when I am in a group of people. ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

9. I often feel nervous when I am in a group of people. ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

10. I often feel nervous when I am in a group of people. ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

11. I often feel nervous when I am in a group of people. ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

12. I often feel nervous when I am in a group of people. ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

13. I often feel nervous when I am in a group of people. ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

14. I often feel nervous when I am in a group of people. ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

15. I often feel nervous when I am in a group of people. ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

16. I often feel nervous when I am in a group of people. ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

17. I often feel nervous when I am in a group of people. ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

18. I often feel nervous when I am in a group of people. ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

19. I often feel nervous when I am in a group of people. ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

20. I often feel nervous when I am in a group of people. ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Name _____

Age _____

Questionnaire

Instructions:

Here are some questions regarding the way you behave, feel and act. After each question there is a "Yes" a "?" and a "No".

Try and decide whether "yes" or "no" represents your usual way of acting or feeling then put a circle round the "Yes" or "No". If you find it impossible to decide put a circle round the "?", but do not use this answer except very occasionally. Work quickly, and don't spend too much time over any question; we want your first reaction, not a long drawn-out process! The whole questionnaire shouldn't take more than a few minutes. Be sure not to omit any questions.

- | | | | |
|---|-----|---|----|
| 1. Are you reserved and distant except to intimate friends? | Yes | ? | No |
| 2. Do you like to mix socially with people? | Yes | ? | No |
| 3. Is your motto to take matters of everyday life with proper seriousness rather than 'laugh and be merry'? | Yes | ? | No |
| 4. Do you enjoy opportunities for conversation so that you rarely miss a change for talking to a stranger? | Yes | ? | No |
| 5. Do you feel it essential to plan ahead carefully before beginning any undertaking | Yes | ? | No |
| 6. Do you tend towards overcautions pessimism? | Yes | ? | No |
| 7. Would you rate yourself as a happy-go-lucky individual? | Yes | ? | No |
| 8. Are you ordinarily a carefree individual? | Yes | ? | No |
| 9. Are you inclined to keep in the background on social occasions? | Yes | ? | No |
| 10. In a group, do you hate having to introduce people to each other? | Yes | ? | No |
| 11. Are you inclined to be shy in the presence of the opposite sex | Yes | ? | No |
| 12. When people shout at you, do you shout back? | Yes | ? | No |
| 13. If you want to learn about something, would you rather do it by reading a book on the subject than by discussion? | Yes | ? | No |
| 14. Do you tend towards a rather reckless optimism? | Yes | ? | No |
| 15. Do you often crave excitement? | Yes | ? | No |
| 16. Are you inclined to keep quiet when out in a social group? | Yes | ? | No |
| 17. Would you be very unhappy if you were prevented from making social contacts? | Yes | ? | No |

- | | | | | |
|-----|--|-----|---|----|
| 18. | Does your natural reserve generally stand in your way when you want to start a conversation with an attractive stranger of the opposite sex? | Yes | ? | No |
| 19. | Would you rather spend an evening by yourself than go to a dull party? | Yes | ? | No |
| 20. | Can you usually let yourself go and have a hilariously good time at a gay party? | Yes | ? | No |
| 21. | Do you usually take the initiative in making new friends? | Yes | ? | No |
| 22. | Are you inclined to stop and think things over before acting? | Yes | ? | No |
| 23. | Are you a person who is not much given to cracking jokes and telling stories to your friends? | Yes | ? | No |
| 24. | Can you readily get some life into a rather dull party? | Yes | ? | No |
| 25. | Do other people regard you as a lively individual? | Yes | ? | No |
| 26. | Do you prefer action to planning for action? | Yes | ? | No |
| 27. | Would you describe yourself as an easy going person not concerned to be precise? | Yes | ? | No |
| 28. | Is it difficult to 'lose yourself' even at a lively party? | Yes | ? | No |
| 29. | On the whole do you prefer the company of books to people? | Yes | ? | No |
| 30. | Are you inclined to limit your acquaintances to a select few? | Yes | ? | No |
| 31. | Would you rate yourself as an impulsive individual? | Yes | ? | No |
| 32. | Do you tend to be slow and deliberate in movement? | Yes | ? | No |
| 33. | Would you do almost anything for a dare? | Yes | ? | No |
| 34. | Are you happiest when you get involved in some project that calls for rapid action? | Yes | ? | No |
| 35. | Do you often act on the spur of the moment without stopping to think? | Yes | ? | No |
| 36. | Do you like to have many social engagements? | Yes | ? | No |
| 37. | Are you given to acting on impulses of the moment which later land you in difficulties? | Yes | ? | No |

APPENDIX C. CORRELATION

MATRIX FOR THE VARIABLES INVESTIGATED

KEY TO COLUMN AND ROW NUMBERS FOR CORRELATION MATRIX

COLUMN NUMBERS	VARIABLE
1.	Inner-Other Directedness
2.	Family Relationships
3.	Social Relationships
4.	Conformity
5.	Neuroticism
6.	Extraversion
7.	Systematization of Knowledge or Theoretical
8.	Economic Concerns
9.	Impulsive Extraversion
10.	Sociable Extraversion

CORRELATION MATRIX FOR THE VARIABLES INVESTIGATED

	1	2	3	4	5	6	7	8	9	10
1.	1.0000	-0.1684	0.3113	-0.2677	-0.0552	-0.2663	0.2832	-0.0773	-0.2994	-0.4092
2.	-0.1684	1.0000	0.0798	0.5684	0.3484	0.1062	0.0684	-0.0262	0.0872	0.0626
3.			1.0000	0.2933	0.3053	-0.5470	0.1536	0.0688	-0.2266	-0.7802
4.				1.0000	0.2373	0.3005	-0.0718	0.0580	0.2431	0.3166
5.					1.0000	-0.1120	0.0436	-0.0835	-0.0029	-0.1746
6.						1.0000	0.0198	0.0249	0.3824	0.6351
7.							1.0000	0.0473	-0.2276	-0.0978
8.								1.0000	0.1559	0.0720
9.									1.0000	0.3267
10.										1.0000

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